MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE (COMBINED) UNDER VARIOUS DEPARTMENT,

GOVERNMENT OF MIZORAM, JULY-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. Laminated core is used to reduce:
   - (a) Hysteresis loss
   - (b) Eddy current loss
   - (c) Copper loss
   - (d) Iron loss

2. 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) 10
   - (b) 15
   - (c) 25
   - (d) 50

3. In closed loop control system, with positive value of feedback gain the overall gain of the system will:
   - (a) decrease
   - (b) increase
   - (c) be unaffected
   - (d) none of these

4. Four identical alternators each are rated for 20 MVA, 11 KV having a sub transient reactance of 16% are working in parallel. The short circuit level at the busbar is:
   - (a) 500 MVA
   - (b) 400 MVA
   - (c) 125 MVA
   - (d) 100 MVA

5. If the armature current of dc series motor has become twice then the torque will become:
   - (a) twice of the former
   - (b) four times of the former
   - (c) one fourth of the former
   - (d) remains same

6. If E_b is the back emf of d.c. motor and V is the terminal voltage, then the condition for maximum power is:
   - (a) $E_b = V$
   - (b) $E_b = 2V$
   - (c) $E_b = (V/2)$
   - (d) $E_b = V^2$

7. If the characteristics equation of a system is $s^2+2=0$, then the system is:
   - (a) Overdamped
   - (b) Underdamped
   - (c) Critically damped
   - (d) Undamped

8. A 3 phase, 400 V, 50 Hz salient pole synchronous motor is running on no load. If there is break in the excitation winding of the motor:
   - (a) the motor will stop
   - (b) the winding will get overheated
   - (c) the motor will run as reluctance motor at the rated rpm
   - (d) the motor will run as reluctance motor at lower rpm.

9. The type 0 system has _____ at the origin.
   - (a) no pole
   - (b) net pole
   - (c) simple pole
   - (d) two poles

10. If the gain of the critical damped system is increased it will behave as:
    - (a) oscillatory
    - (b) critically damped
    - (c) overdamped
    - (d) underdamped

11. In force-voltage analogy, velocity is analogous to:
    - (a) current
    - (b) charge
    - (c) inductance
    - (d) capacitance

12. While increasing the value of gain K, the system becomes:
    - (a) less stable
    - (b) more stable
    - (c) unstable
    - (d) absolute stable

13. Commutator in DC generator is used for:
    - (a) collecting of current
    - (b) reduce losses
    - (c) increase efficiency
    - (d) convert AC armature current in to DC

14. The direction of the current in the compensating winding is _____ to the direction of current in the armature conductors.
    - (a) same
    - (b) exactly opposite
    - (c) both (a) & (b)
    - (d) none of these

15. A shunt generator is running at 1000 rpm. If the flux is reduced by half, then what is the new speed such that generated voltage remains the same?
    - (a) 0
    - (b) 500
    - (c) 1000
    - (d) 2000

16. Which point on root locus specifies the meeting or collision of two poles?
    - (a) Centroid
    - (b) Break away point
    - (c) Stability point
    - (d) Anti-break point

17. The sag of a transmission line conductor in summer is:
    - (a) less than that in winter
    - (b) more than that in winter
    - (c) same as in winter
    - (d) none of these

18. In a three-phase synchronous motor, the magnitude of field flux:
    - (a) varies with power factor
    - (b) remains constant at all loads
    - (c) varies with load
    - (d) varies with speed

19. Pull-out torque in an induction motor occurs when power factor becomes:
    - (a) 0.5
    - (b) 0.707
    - (c) 1
    - (d) None

20. A synchronous compensator absorbs inductive reactive power. It is:

(a) overexcited
(b) normally excited
(c) under excited
(d) none of these

21. A 6 pole, 50 Hz, 3 phase induction motor is running at 950rpm and has rotor cu loss of 5 kW. The rotor input is:

(a) 5 kW
(b) 10 kW
(c) 50 kW
(d) 100 kW

22. 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%

23. The negative feedback closed-loop system was subjected to 15V. The system has a forward gain of 2 and a feedback gain of 0.5. Determine the output voltage and the error voltage.

(a) 15V, 10V
(b) 6V, 5V
(c) 15V, 7.5V
(d) 5V, 10V

24. Steady-state stability of a power system is the ability of the power system to:

(a) maintain voltage at the rated voltage level.
(b) maintain frequency exactly at 50 Hz.
(c) maintain a spinning reserve margin at all times.
(d) maintain synchronism between machines and on external tie lines.

25. In load flow studies of a power system, a voltage control bus is specified by:

(a) real power and reactive power.
(b) reactive power and voltage magnitude.
(c) voltage and voltage phase angle.
(d) real power and voltage magnitude.

26. A 440 V 50 Hz 6 pole induction motor has speed of 950 rpm then slip of motor is:

(a) 1%
(b) 5%
(c) 3%
(d) 10%

27. Transmission lines are transposed to reduce:

(a) ferranti effect
(b) skin effect
(c) proximity effect
(d) interference with neighbouring communication lines

28. Which D.C. motor is generally preferred for cranes and hoists?

(a) Series motor
(b) Shunt motor
(c) Cumulatively compounded motor
(d) Differentially compounded motor

29. A shunt generator running at 1000 r.p.m. has generated e.m.f. as 200 V. If the speed increases to 1200 r.p.m., the generated e.m.f. will be nearly:

(a) 150 V
(b) 175 V
(c) 240 V
(d) 290 V

30. For a 5 bus network system, given that 2 buses are connected to the generator, find the size of Jacobian matrix for such system.

(a) 5×5
(b) 6×6
(c) 7×7
(d) 8×8

31. The open loop transfer function of a unity feedback control system is given as:

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

The value of 'a' to give a phase margin of 45° is equal to:
(a) 0.141
(b) 0.441
(c) 0.841
(d) 1.141

32. The closed loop transfer function for a second order system is: $T(s) = 4/(s^2 + 4s + 4)$. The settling time for a 2 percent band will be:
(a) 2 seconds
(b) 1.5 seconds
(c) 2.5 seconds
(d) 1 second

33. The efficiency of the transformer will be maximum when:
(a) iron losses is equal to the twice of the copper losses
(b) copper losses is equal to the twice of the iron losses
(c) iron losses is equal to the copper losses
(d) all of these

34. Series capacitor is used in a transmission line to:
(a) compensate the voltage drop
(b) reduce line losses
(c) limit short-circuits current
(d) improve load power factor

35. The initial slope of bode plot for a transfer function having single pole at origin is:
(a) 20 db/decade
(b) -40 db/decade
(c) 40 db/decade
(d) -20 db/decade

36. Distribution transformers are generally designed for maximum efficiency around:
(a) 90% of full load
(b) 100% of full load
(c) 25% of full load
(d) 50% of full load

37. The transfer function of a linear time invariant system is given as:

$$G(s) = \frac{1}{(s^2 + 3s + 2)}$$

The steady state value of the output of the system for a unit impulse input applied at time instant t = 1 will be:
(a) 0
(b) 0.5
(c) 1
(d) 2

38. The Nyquist plot of loop transfer function G(s)H(s) of a closed loop control system passes through the point (-1, j 0) in the G(s)H(s)plane. The phase margin of the system is:
(a) 0°
(b) 45°
(c) 90°
(d) 180°

39. The induced emf in a dc machine while running at 500 rpm is 180 V. The induced emf when the machine is running at 600 rpm (Assume constant flux) will be:
(a) 216 V
(b) 210 V
(c) 1666.66 V
(d) None of these

40. In terms of bode plot, the system is stable if:

    (a) P.M=G.M
    (b) P.M and G.M both are positive
    (c) P.M and G.M both are negative
    (d) P.M negative but G.M positive

41. A 6-pole, wave connected armature has 250 conductors and runs at 1200 rpm. The emf generated on open circuit is 600 V. The useful flux per pole will be:

    (a) 0.03 Wb
    (b) 0.04 Wb
    (c) 0.02 Wb
    (d) 0.06 Wb

42. For the transfer function $G(s)=K/s(s^2+6s+10)$, the number of asymptotes are:

    (a) 3
    (b) 2
    (c) 4
    (d) 6

43. A 12-pole, 50 Hz, three phase induction motor runs at 485 rpm. The frequency of the rotor current will be:

    (a) 2.5 Hz
    (b) 2 Hz
    (c) 1.5 Hz
    (d) 3 Hz

44. An infinite bus-bar should maintain:

    (a) infinite frequency and infinite voltage
    (b) constant frequency and constant voltage
    (c) constant frequency but variable voltage
    (d) variable frequency and variable voltage

45. Corona loss increases with:

    (a) decrease in conductor size and increase in supply frequency.
    (b) increase in both conductor size and supply frequency.
    (c) decrease in both conductor size and supply frequency.
    (d) increase in conductor size and decrease in supply frequency

46. Function of conservator in an electrical transformer is:

    (a) supply cooling oil to transformer in time of need
    (b) provide fresh air for cooling the transformer
    (c) protect the transformer from damage when oil expends due to heating
    (d) cannot be determined

47. Ferranti effect happens in transmission line when the line is:

    (a) short and loaded
    (b) long and loaded
    (c) long and unloaded
    (d) none of these

48. A transmission line has a reactance of 1 Pu is operating at Vs = Vr = 1 Pu. The generator is connected at source end which is delivering 0.5 Pu of active power. Find the load angle?

    (a) 35°
    (b) 30°
    (c) 45°
    (d) 60°

49. Economic studies have shown that D.C. transmission is cheaper than A.C. transmission for lengths:

    (a) below 300 km
    (b) beyond 200 km
    (c) beyond 600 km
    (d) beyond 1000 km

50. Bundled conductors are used to:

    (a) reduce inductance of the line.
    (b) reduce both inductance and capacitance.
    (c) reduce corona loss.
    (d) reduce corona loss and the line inductance.

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. Explain working principle of auto transformer with proper circuit diagram.

2. Explain the transient and steady state stability of power system.

3. Explain briefly the working of minimum SF_6 breaker with a neat diagram.

4. Define per unit system and advantages of per unit system?

5. Apply the Routh-Hurwitz criterion to the following equation and investigate the stability.
   $s^4+8s^3+18s^2+16s+5=0$

6. With a neat schematic diagram explain briefly the working of a nuclear power station.

7. Derive an expression for the fault current for the LG fault.

8. What is armature reaction in DC machine? State its disadvantages.

9. Define state variable? State the properties of State Transition Matrix.

10. What is hunting in the alternator? Discuss the measures to be taken to minimize such hunting.

11. Derive the swing equation for the synchronous generator.

12. Discuss various methods of controlling reactive power at load end to keep consumer terminal voltage fixed.

13. A dc shunt machine connected to 250 mains, has an armature resistance of $0.12\,\Omega$, and the resistance of the field circuit is $100\ \Omega$. Calculate the ratio of the speed as a generator to the speed as motor, the line in each case being 80A.

14. A particular 3-phase, 4-pole, induction motor has rotor resistance of $0.04\ \Omega$ per phase. The maximum torque occurs at a speed of 1200 rpm. Calculate the starting torque as percentage of maximum torque.

15. Induction motor cannot run at synchronous speed, Explain. If the motor is made to run above the synchronous speed, how will it behave?

16. Describe the principle operation and torque speed characteristics of an induction generator.

17. The open-loop transfer function of a unity feedback control system is given by
   $$G(s)=\frac{9}{s(s+3)}.$$

   Find the natural frequency of response, damping ratio, damped frequency and time constant.

18. What do you mean by Bode plot? What are its advantages? How is stability determined from Bode plot?

19. Explain why parallel operation of transformmer is necessary.

20. Describe briefly the process of voltage build-up in a self-excited shunt DC Motor. What are the conditions for voltage build-up in a DC Motor?

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