MIZORAM PUBLIC SERVICE COMMISSION

TECHNICAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO JUNIOR GRADE OF MIZORAM ENGINEERING SERVICE UNDER POWER & ELECTRICITY DEPARTMENT, NOVEMBER, 2015

ELECTRICAL ENGINEERING
PAPER - II

Time Allowed : 3 hours | Full Marks : 200

Attempt all questions.

Part A - Objective Type Questions (100 Marks)

All questions carry equal marks of 2 each.

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

1. If the system specifications are given in time domain, best approach for designing is
(a) Nyquist plot (b) Bode plot
(c) Root locus (d) Any of these

2. Signal flow graph is used to obtain
(a) stability of a system (b) transfer function of a system
(c) controllability of a system (d) absorbability of a system

3. As compared to a 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

4. Which compensator is used to increase the damping of a badly under-damped system?
(a) Phase-lag (b) Phase-lead
(c) Phase lag-lead (d) None of these

5. In pneumatic systems, electrical capacitance is analogous to
(a) restriction to flow (b) volume of air
(c) filled helical tube (d) none of these

6. Transformer cores are laminated to reduce
(a) eddy current loss (b) hysteresis loss
(c) both eddy current and hysteresis loss (d) ohmic loss

7. Oil in transformer is used for
(a) lubrication purpose (b) insulation
(c) cooling (d) both (b) and (c)

8. The open circuit test on a transformer is mainly carried out to determine
(a) copper loss (b) core loss
(c) total loss (d) insulation resistance

9. While conducting short-circuit test on a transformer, which side is generally short-circuited?
(a) H.V. side (b) L.V. side
(c) Primary side (d) Secondary side

10. Direction of rotation of rotor in a d.c. motor is given by
(a) Faraday's law (b) Fleming's right hand rule
(c) Fleming's left hand rule (d) Lenz's law

11. A d.c. series motor should not be started without a load on it because
(a) it will not run at no load
(b) it may develop excessive speed at no-load and thus damage itself
(c) excessive sparking will occur at commutator
(d) the staring current will be very high

12. Which of the following plants has the minimum running cost?
(a) nuclear (b) thermal
(c) hydro (d) diesel

13. The advantage of transmitting power at high voltage is
(a) magnitude of current will be small (b) it will reduce the voltage drop in the line
(c) power loss will be less (d) all of these

14. In the protection scheme, relay functions as a
(a) switching device (b) sensing device
(c) breaking device (d) none of these

15. The most common type of fault is
(a) single-phase to ground (b) phase-to-phase
(c) two-phase to ground (d) three-phase to ground

16. HVDC transmission is mainly used for
(a) bulk power transmission over very long distances
(b) interconnecting two systems with the same nominal frequency
(c) eliminating reactive power requirement in the operation
(d) minimizing harmonics at the converter stations

17. The transfer function of a tachometer is of the form
(a) KS (b) k/s
(c) k/(S+1) (d) k/S(S+1)

18. In a speed control system, output rate feedback is used to
(a) Limit the speed of motor. (b) Limit the acceleration of the motor.
(c) Reduce the damping of the system. (d) Increase the gain margin.

19. The transfer function of a system is given as $\frac{100}{s^2+20s+100}$. The system is
(a) an overdamped system (b) an underdamped system
(c) a critically damped system (d) an unstable system

20. A phase-lag compensator will
(a) improve relative stability (b) increase the speed of response
(c) increase bandwidth (d) increase overshoot

21. If the armature current is increased to double its previous value, and the time of commutation is halved, how will the reactance voltage vary?

(a) It will be halved
(b) It will remain the same
(c) It will be doubled
(d) It will become four times

22. Synchronous generators used in thermal power plants have

(a) Cylindrical rotors
(b) Salient pole rotors
(c) Stator slots in multiple of 6
(d) All of these

23. How can the reactive power delivered by a synchronous generator be controlled?

(a) By changing the prime mover input
(b) By changing the excitation
(c) By changing the direction of rotation
(d) By changing the prime mover speed

24. A cylindrical rotor synchronous motor with damper windings is switched on without dc supply to its field windings. It will

(a) not start
(b) start but not run at synchronous speed
(c) start as an induction motor and then run as a synchronous motor
(d) start and run as a synchronous motor

25. In hand tool applications, which of the following single–phase motor is used?

(a) Shaded pole motor
(b) Capacitor start motor
(c) Capacitor run motor
(d) Universal motor

26. Bundled conductors in EHV transmission lines results in

(a) Reduced capacitance
(b) Increased capacitance
(c) Increased inductance
(d) Decreased inductance

27. The rating of a 3–phase power system is given as

(a) rms phase voltage
(b) peak phase voltage
(c) rms line to line voltage
(d) peak line to line voltage

28. HVDC transmission lines are more economical for

(a) Short distance transmission
(b) Long distance transmission
(c) Any distance transmission
(d) Interconnected systems

29. The characteristic equation of a system is given as:

$$2s^4 + s^3 + 3s^2 + 5s + 10 = 0$$

How many roots does the system will have?

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

30. Which of the following compensations is adopted for improving transient response of a negative unity feedback system?

(a) Phase lead compensation
(b) Phase lag compensation
(c) Gain compensation
(d) Both (b) and (c)

31. A negative sequence relay is commonly used to protect

(a) An alternator
(b) A transformer
(c) A transmission line
(d) A bus bar

32. 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.

33. Which three-phase connection can be used in a transformer to introduce a phase difference of 30^{o} between its output and corresponding input time voltages?

(a) Star-Star (b) Star-Delta

(c) Delta-Delta (d) Delta-Zigzag

34. Which of the following motors definitely has a permanent magnet rotor?

(a) DC commutator motor (b) Brushless DC motor

(c) Stepper motor (d) Reluctance motor

35. The phase sequence of a three phase alternator will reverse if

(a) The field current is reversed keeping the direction of rotation same

(b) The field current remains the same but the direction of rotation is reversed

(c) The field current is reversed and the number of poles is doubled

(d) The number of poles is doubled without reversing the field current

36. The dc motor, which can provide zero speed regulation at full load without any controller is

(a) series (b) shunt

(c) cumulative compound (d) differential compound

37. Shunt reactors are sometimes used in high voltage transmission system to

(a) limit the short circuit current through the line.

(b) compensate for the series reactance of the line under heavily loaded condition.

(c) limit over-voltages at the load side under lightly loaded condition.

(d) compensate for the voltage drop in the line under heavily loaded condition.

38. MHO relay is normally used for protection of

(a) Short line (b) Long line

(c) Medium line (d) None of these

39. A Buchholz relay is used for

(a) Protection of induction motor

(b) Protection of synchronous motor

(c) Protection of transformer against external fault

(d) Protection of transformer against internal fault

40. The insulation of modern EHV is designed based on

(a) Lightening voltage (b) Switching voltage

(c) Corona voltage (d) Radio Interference

41. Which of the following circuit breakers produce least arc energy?

(a) Air circuit breaker (b) Oil circuit breaker

(c) Vacuum circuit breaker (d) Air blast circuit breaker

42. The basic function of a transformer is to change

(a) The power level (b) Voltage level

(c) Power factor (d) Frequency

43. A negative feedback closed loop system is supplied to an input of 5 volt. The system has a forward gain of 1 and a feedback gain of 1. What is the output voltage?

(a) 1.0 V (b) 2.5 V

(c) 1.5 V (d) 2.0 V

44. Time response for a second order system depends on value of æ If æ= 0 then the system is called as

(a) Un-damped system (b) Under damped system

(c) Critically damped system (d) Over damped system

45. The function of commutator in a d.c. generator is

(a) to collect current from armature conductors (b) to improve commutation

(c) to conduct current to the brushes (d) to change a.c. to d.c.

46. The function of starter in d.c. motors is

(a) to avoid excessive current at starting (b) to control the speed

(c) to avoid armature reaction (d) to avoid excessive heating

47. The efficiency of a d.c. machine is maximum when

(a) the machine is running at full-load (b) the machine is running at no-load

(c) the variable loss equals the constant loss (d) none of these

48. Which motor can conveniently operate at lagging as well as leading power factor?

(a) squirrel-cage induction motor (b) wound-rotor induction motor

(c) synchronous motor (d) d.c. shunt motor

49. Which portion of the power system is more prone to faults?

(a) Alternators (b) Transformers

(c) Overhead lines (d) Underground cables

50. Salient pole type rotors are generally used with prime movers of

(a) high speed (b) low speed

(c) medium speed (d) both high and low speed

Part B - Short Answer Questions (100 Marks)

All questions carry equal marks of 5 each.

*This Part should be answered only on the **Answer Booklet** provided.*

1. In what respects is 'Nyquist stability criterion' better than 'root locus technique' and 'Routh criterion'? Explain.

2. State and explain the conditions to be satisfied for satisfactory parallel operation of transformers.

3. What is a pumped storage scheme, and what are its advantages and disadvantages?

4. What are the advantages and disadvantages of using high transmission voltages? Also discuss the factors that influence the choice of the most economical transmission voltage.

5. What is a static relay? What are the advantages and disadvantages of these relays over electromagnetic relays?

6. What is meant by the frequency response of a control system? Explain.

7. Define the terms: Resonant peak, resonant frequency, bandwidth, cut-off frequency.

8. Define the terms 'efficiency' and 'regulation' of a transformer. What is the condition for maximum efficiency of a transformer?

9. Write briefly the various methods of speed control of dc shunt motor?

10. How a double caged rotor of an induction motor differ from a normal single cage rotor?

11. What are the advantages of using a stationary armature in large synchronous generators?

12. Explain clearly the basic principle of operation of a differential relay.

13. The state variable description of a linear autonomous system is $\dot{X}=AX$, where X is a two dimensional vector and A is a matrix given by A= . Determine the pole values of the system.

14. A single-phase transformer has a maximum efficiency of 90% at full load and unity power factor. Determine the efficiency at half load at the same power factor.

15. Draw and explain the slip-torque characteristic of a 3 phase induction motor.

16. A 1000 kVA, 6.6 kV, 3-phase star connected cylindrical pole synchronous generator has a synchronous reactance of 20 . Neglect the armature resistance and consider operation at full load and unity power factor. Determine the Induced EMF of the machine in (Line to Line).

17. Explain the mechanism of power transfer from primary to secondary of a transformer, showing how the primary draws more current when the load on the secondary increases.

18. What is armature reaction? What are the effects of armature reaction on the performance of generators? What is done to overcome these effects? Explain.

19. Describe, with the help of a neat sketch, the working of a 3-point starter.

20. A shunt generator has an induced voltage of 127 V on open circuit. When the machine is on load, the terminal voltage is 120 V. Find the load current if the field circuit resistance is 15 and the armature resistance 0.02 . Ignore armature reaction.

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