

MIZORAM PUBLIC SERVICE COMMISSION
DEPARTMENTAL EXAMINATION FOR JUNIOR GRADE OF M.E.S. (AE/SDO)
UNDER POWER & ELECTRICITY DEPARTMENT, GOVERNMENT OF MIZORAM.
(JULY-2025)

ENGINEERING PAPER – II
(Mechanical Engineer under Electrical Wing)

Time Allowed : 3 hours

FM : 100 PM : 40

SECTION - A (Multiple Choice questions) (50 Marks)

All questions carry equal mark of 1 each. Attempt all questions.

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

1. How are turbines classified based on the energy available at the inlet?
 - (a) Tangential, radial, and axial flow
 - (b) High head, medium head, and low head
 - (c) Impulse and reaction turbines
 - (d) Mixed flow and tangential flow
2. What does a high specific speed for a turbine imply?
 - (a) The turbine will have a larger size for the same power output compared to an impulse turbine.
 - (b) The turbine is better suited for high-head, low-flow applications.
 - (c) The turbine is likely an impulse turbine.
 - (d) The turbine will be smaller in size and will generate more power for the same head
3. What is the hydraulic efficiency of a turbine?
 - (a) The ratio of power delivered to the runner to the power supplied at the inlet
 - (b) The ratio of power at the shaft to the power delivered to the runner
 - (c) The ratio of shaft power to the total power supplied by the water
 - (d) The ratio of power generated to the water power input
4. Where is cavitation most likely to occur in a hydraulic turbine?
 - (a) At the inlet of the penstock.
 - (b) On the surface of the runner vanes.
 - (c) At the inlet of the draft tube.
 - (d) On the casing of the turbine.
5. What is the primary function of a governor in a hydropower plant?
 - (a) To increase the speed of the turbine
 - (b) To maintain a constant speed of the turbine despite load changes
 - (c) To shut down the turbine in case of an emergency
 - (d) To control the active power generation
6. In a Francis turbine, what does the governor control to regulate the water flow?
 - (a) The spear nozzle
 - (b) The draft tube
 - (c) The wicket gates
 - (d) The runner blades

7. For a head of 10-70 meters, which turbine is the most suitable choice?
 - (a) Pelton Turbine
 - (b) Kaplan Turbine
 - (c) Francis Turbine
 - (d) None of the above
8. The primary purpose of performance testing a turbine is to determine its:
 - (a) Specific speed
 - (b) Maximum power output and efficiency
 - (c) Physical dimensions
 - (d) Operating noise level
9. Testing of a newly installed turbine is often performed to ensure it meets the manufacturer's guaranteed performance and efficiency under specific operating conditions, also known as
 - (a) Commissioning tests
 - (b) Maintenance tests
 - (c) Research tests
 - (d) Reliability tests
10. What is the primary purpose of specific speed (N_s) of a centrifugal pump?
 - (a) To determine the pump's power consumption.
 - (b) To determine the pump's hydraulic efficiency.
 - (c) To compare the performance of different pumps and characterize their design.
 - (d) To calculate the pump's flow rate at different speeds.
11. Before starting the electric motor of a centrifugal pump, which action is mandatory?
 - (a) Ensuring the delivery valve is open
 - (b) Checking that the pump is properly primed
 - (c) Adjusting the speed of the motor to maximum
 - (d) Closing the suction valve
12. What type of electric motor is typically used to drive pumps due to its robust nature and common availability?
 - (a) DC series motor
 - (b) Single-phase induction motor (for large pumps)
 - (c) Three-phase, squirrel cage induction motor
 - (d) Universal motor
13. The motor's nameplate power rating should always be _____ the power required to drive the pump at its design condition.
 - (a) less than
 - (b) equal to
 - (c) greater than
 - (d) half of
14. Which of the following is a necessary component for a centrifugal pump to be able to self-prime?
 - (a) A draft tube
 - (b) A separate priming chamber or internal suction stage
 - (c) A larger impeller
 - (d) A high-speed motor
15. What is one of the main indicators that a centrifugal pump is experiencing cavitation?
 - (a) A steady, high-pitched whine
 - (b) A sudden increase in discharge pressure
 - (c) A rattling or hammering noise
 - (d) Smooth, vibration-free operation
16. A vertical turbine pump is primarily used to move water from what sources?
 - (a) Shallow ponds
 - (b) Above-ground storage tanks
 - (c) Underground wells or reservoirs
 - (d) Pressurized pipelines

17. Which of the following is the most crucial fluid property to consider when selecting a centrifugal pump, as it directly impacts the required motor power?
- (a) Color of the fluid
 - (b) Odour of the fluid
 - (c) Specific gravity of the fluid
 - (d) Boiling point of the fluid
18. Which of the following is an advantage of multi-stage air compression?
- (a) Increased leakage loss
 - (b) Reduced work input
 - (c) Lower volumetric efficiency
 - (d) Increased discharge temperature
19. Gas turbines are best suited for which type of power plant application?
- (a) Base load power plants
 - (b) Peak load power plants
 - (c) Geothermal power plants
 - (d) Nuclear power plants
20. What is the purpose of a hoisting chain?
- (a) To transfer power between sprockets
 - (b) To lift heavy loads and materials
 - (c) To transmit motion in a machine
 - (d) To measure distances on a field
21. Which type of gear is used to transmit power between two shafts that are parallel to each other?
- (a) Bevel gear
 - (b) Worm gear
 - (c) Spur gear
 - (d) Spiral bevel gear
22. Which of the following is a correct statement?
- (a) A flywheel regulates speed during one cycle while the governor regulates speed from cycle to cycle.
 - (b) The flywheel is an essential element of every prime mover.
 - (c) A flywheel controls the quantity or quality of the working agent.
 - (d) A governor regulates speed by storing kinetic energy.
23. For having the highest fin effectiveness for heat transfer, the fins should be:
- (a) Long and thin
 - (b) Short and thick
 - (c) Short and thin
 - (d) Long and thick
24. Which of the following processes is used in winter air conditioning to provide comfort?
- (a) Cooling and dehumidification
 - (b) Heating and humidification
 - (c) Dehumidification only
 - (d) Humidification only
25. Which of the following is a major application of gas welding, particularly for repair work?
- (a) Shipbuilding
 - (b) Piping systems
 - (c) Repairing sheet metal
 - (d) Structural steel fabrication
26. What is the primary purpose of laminating a transformer core?
- (a) To increase flux density
 - (b) To reduce eddy current losses.
 - (c) To improve insulation
 - (d) To increase mechanical strength
27. Which component absorbs moisture from the air during a transformer's "breathing"?
- (a) Conservator
 - (b) Radiator
 - (c) Breather (Silica Gel)
 - (d) Buchholz Relay
28. When is the efficiency of a transformer maximum?
- (a) At no load
 - (b) When copper loss equals iron loss
 - (c) At half load
 - (d) When voltage is maximum

29. Why are off-load tap changers operated only when the transformer is de-energized?
- (a) To prevent sparking
 - (b) To avoid damaging the mechanism
 - (c) To ensure safety and proper contact engagement
 - (d) They don't require power
30. Where should lightning arresters be installed for optimal transformer protection?
- (a) Inside the transformer tank
 - (b) At the termination point of overhead lines leading to the transformer
 - (c) On the ground below the transformer
 - (d) Only on the low-voltage side
31. What is the benefit of proper grounding for lightning protection?
- (a) It attracts more lightning strikes.
 - (b) It stores the lightning energy.
 - (c) It provides a low-resistance path for surge current to dissipate into the earth safely.
 - (d) It creates a magnetic field to deflect strikes
32. What is the primary protection for Power transformers against internal faults?
- (a) Fuse Protection
 - (b) Overcurrent Relay
 - (c) Differential Protection (Main) & Gas (Buchholz) Protection
 - (d) Thermal Relay
33. Which relay protects the transformer from external short circuits and overloads?
- (a) Differential Relay
 - (b) Buchholz Relay
 - (c) Overcurrent Relay
 - (d) Thermal Relay
34. Restricted Earth Fault (REF) protection covers faults in:
- (a) The entire winding
 - (b) Part of the winding between neutral and tapping point
 - (c) Only the HV side
 - (d) Only the LV side
35. What is magnetizing inrush current?
- (a) Current during heavy load
 - (b) Current during fault
 - (c) A transient rush of current (6 to 8 times rated current) when first energized
 - (d) Current during unloading
36. How does earthing contribute to system stability?
- (a) By introducing resistance in the neutral
 - (b) By providing a stable reference point (zero potential) for the system
 - (c) By increasing system impedance
 - (d) By creating an isolated neutral

37. In case of an insulation failure, earthing provides:
- (a) A high-resistance path
 - (b) The easiest path for short-circuit current to flow to the ground
 - (c) A path to the live wire
 - (d) An open circuit
38. What is the primary purpose of the Insulation Resistance (Megger) test of a Transformer?
- (a) To measure copper losses
 - (b) To check winding insulation health
 - (c) To determine core losses
 - (d) To verify turns ratio
39. What is the primary instrument used specifically for measuring earth resistance?
- (a) Ammeter
 - (b) Voltmeter
 - (c) Earth Tester (or Ground Resistance Tester)
 - (d) Frequency Meter
40. The primary consideration for a transmission substation site is:
- (a) Proximity to residential areas
 - (b) High population density
 - (c) Proximity to load centers & transmission line corridors
 - (d) Close to airports
41. A major constraint for substation location is proximity to:
- (a) River crossings
 - (b) Industrial zones
 - (c) Airports & defense establishments
 - (d) Agricultural lands
42. What is a common maintenance task for Power Transformers in outdoor substations?
- (a) Changing the tank paint every year.
 - (b) Checking oil level, colour, and moisture content, plus oil testing.
 - (c) Removing all bushings for cleaning.
 - (d) Reducing the load to below 50%.
43. What is the main goal of preventive maintenance in an outdoor substation?
- (a) To fix faults immediately after they occur.
 - (b) To identify and rectify potential issues *before* they cause failure, ensuring reliability.
 - (c) To repaint everything every few years.
 - (d) To replace all equipment every decade
44. What is the primary purpose of switchgear in an electrical power system?
- (a) To generate electricity
 - (b) To step up or step down voltage levels
 - (c) To protect, control, and isolate electrical equipment
 - (d) To measure power consumption

- 45.** The function of a protective relay is to:
- (a) Detect the fault and initiate the operation of the circuit breaker
 - (b) Absorb the fault current
 - (c) Step down the voltage for metering
 - (d) Provide an alarm only during a fault
- 46.** An instantaneous over-current relay operates:
- (a) With a time delay that is inversely proportional to the current
 - (b) Immediately when the current exceeds a predetermined value
 - (c) After a fixed, definite time delay
 - (d) Only for earth faults
- 47.** Which protection scheme is generally recommended for Power transformers with a rating above 5MVA?
- (a) Over-current protection
 - (b) Differential protection
 - (c) Restricted Earth Fault protection
 - (d) Buchholz relay
- 48.** The common type of storage battery generally used in electric power stations is the:
- (a) Nickel-cadmium battery
 - (b) Zinc-carbon battery
 - (c) Lead-acid battery
 - (d) Lithium-ion battery
- 49.** Which of the following activities is typically part of routine (preventive/scheduled) maintenance of HT/LT ABC lines?
- (a) Replacement of worn-out parts
 - (b) Troubleshooting during a breakdown
 - (c) Regular inspection for physical damage, wear or sagging of the cable
 - (d) Re-varnishing of the cable
- 50.** If a section of LT ABC is experiencing frequent faults due to illegal tapping (hooking), which inherent feature of ABC helps mitigate this issue?
- (a) The use of a messenger wire
 - (b) The insulated nature of all conductors
 - (c) Its high mechanical strength
 - (d) Its ability to be run concurrently with communication lines

SECTION - B (50-MARKS)

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

Marks for each question is indicated against it.

Attempt all questions.

1. What are the primary factors determining the choice of a hydraulic turbine? How does the “head” (available height of water) influence turbine selection? (4)
2. What determines the power required to drive a hydraulic pump? What happens if the driving motor is oversized or undersized? (4)
3. Why use multi-stage compression instead of single-stage? Does multi-stage compression increase the final delivery pressure compared to a single-stage compressor? (5)
4. What are the main applications of gas turbines in power generation? What type of fuel do gas turbines use? (4)
5. What are the primary functions of Flywheel and Governor in Engine Speed regulation? (4)
6. What is Break-Even Analysis? Why is it Important? (4)
7. Why are transformer ratings given in kVA, not kW? (2)
8. What is the primary purpose of earthing in a transformer system? What happens if a transformer system is not properly earthed (an isolated neutral system)? (4)
9. Mention desirable earth resistance values for Power Transformers/Sub-Stations and Distribution Transformers/ Structures. (3)
10. How do you measure the insulation resistance (IR) and Polarization Index (PI) of a transformer? (3)
11. Mention the main applications of Current Transformers (CT). Why must the secondary winding of a CT never be open-circuited while the primary is energized? (4)
12. If external Current transformer ratio (CTR) or Connected CT ratio is 200/5, external Potential transformer ratio (PTR) or Connected PT ratio is 11000/110 Volts, Energy Meter CT Ratio is 100/5 and Energy Meter PT Ratio is 11000/110 Volts, What is Multiplying Factor of that Energy Meter? (2)
13. What are the primary advantages of using Aerial Bunched Cable (ABC) over bare overhead lines? What common faults occur in ABC systems and how are they detected? (5)
14. What are the common problems associated with EHV/HV transmission lines that require maintenance? (2)

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