

MIZORAM PUBLIC SERVICE COMMISSION
DEPARTMENTAL EXAMINATION FOR JUNIOR GRADE OF M.E.S. (AE/SDO)
UNDER POWER & ELECTRICITY DEPARTMENT,
GOVERNMENT OF MIZORAM, DECEMBER-2024.

ENGINEERING PAPER – II
(Mechanical Engineer under Electrical Wing)

Time Allowed : 3 hours

FM : 100 PM : 40

PART - 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. Francis, Kaplan and propeller turbines fall under the category of-
 - (a) Impulse turbine
 - (b) Reaction turbines
 - (c) Axial flow turbines
 - (d) Mixed flow turbines
2. The specific speed of a turbine is the speed of such a turbine, identical with a given turbine, which-
 - (a) Develops unit power under unit head
 - (b) Develops unit power under unit discharge
 - (c) Develops unit speed under unit head
 - (d) Delivers unit discharge under unit head
3. The ratio of power produced by the turbine to the energy actually supplied by the turbine is-
 - (a) Mechanical efficiency of the turbine
 - (b) Hydraulic efficiency of the turbine
 - (c) Overall efficiency of the turbine
 - (d) Relative efficiency of the turbine
4. Cavitation in hydraulic turbine results in-
 - (a) Noise and vibration
 - (b) reduction and discharge
 - (c) drop in output and efficiency
 - (d) rough surfaces
5. Draft tube at the exit of a Reaction turbine used for hydroelectric project is-
 - (a) above or below the water surface, depends on unit speed of the turbine
 - (b) always above the water surface
 - (c) always immersed in water
 - (d) may either be below or above the water surface
6. The governing of water turbine refers to-
 - (a) Maintain the discharge constant under all conditions
 - (b) Maintain the speed constant under all conditions
 - (c) Allow the turbine to run at runaway speed
 - (d) Maintain the power constant under all conditions
7. Governing mechanism used in case of pelton wheel turbine is-
 - (a) Guide vane
 - (b) Nozzle needle
 - (c) Control valve
 - (d) Dam gates

8. Governing mechanism used in case of Francis and Kaplan turbines is-
- (a) Guide vane
 - (b) Nozzle needle
 - (c) Control valve
 - (d) Dam gates
9. On what principal does a reciprocating pump work?
- (a) Centrifugal force
 - (b) Rotation of impeller to develop lifting pressure
 - (c) Create a reciprocating motion by sucking and discharge of fluid by using piston
 - (d) Forced vortex flow
10. On what principal does a centrifugal pump work?
- (a) Centrifugal force
 - (b) Rotation of impeller to develop lifting pressure
 - (c) Create a reciprocating motion by sucking and discharge of fluid by using piston
 - (d) Forced vortex flow
11. The specific speed of a centrifugal pump is given by-
- (a) $\frac{N\sqrt{Q}}{H^{2/3}}$
 - (b) $\frac{N\sqrt{Q}}{H^{3/4}}$
 - (c) $\frac{N\sqrt{Q}}{H}$
 - (d) $\frac{N\sqrt{Q}}{H^{5/4}}$
12. The inlet passage of centrifugal pump is controlled by-
- (a) Gate
 - (b) Head race
 - (c) Turbine
 - (d) Pump
13. Centrifugal pump is started with its delivery valve-
- (a) kept fully closed
 - (b) kept fully opened
 - (c) irrespective of any position
 - (d) kept 50% opened
14. In centrifugal pumps, maximum efficiency is obtained when the blades are-
- (a) Straight
 - (b) bent forward
 - (c) bent backward
 - (d) radial
15. When a centrifugal pump casing is filled with liquid before it is started, it is called as-
- (a) Adiabatic expansion
 - (b) Priming
 - (c) Adiabatic compression
 - (d) Isentropic expansion
16. What is necessary for self priming to take place?
- (a) Draft tube
 - (b) Pump casing
 - (c) Suspended Solenoids
 - (d) Turbine head
17. To avoid cavitation in centrifugal pumps-
- (a) suction pressure should be low
 - (b) delivery pressure should be low
 - (c) suction pressure should be high
 - (d) delivery pressure should be high
18. If requirement of Net Positive Suction Head (NPSH) of a centrifugal pump is not satisfied-
- (a) Pump will not develop head
 - (b) Pump will be cavitated
 - (c) pump efficiency will be low
 - (d) no flow will take place

19. Multi-stage centrifugal pumps are used to obtain-
- (a) High discharge
 - (b) High head
 - (c) Pumping of viscous fluids
 - (d) High head and high discharge
20. A turbine pump is basically a centrifugal pump equipped additionally with-
- (a) adjustable blades
 - (b) backward curved blades
 - (c) vaned diffusion casing
 - (d) inlet guide blades
21. Role of pump testing is-
- (a) To measure pressure, flow rates and speeds
 - (b) To measure input and output power
 - (c) To measure noise emissions, strength levels and vibrations
 - (d) All of the above
22. In a hydraulic crane, the component mainly responsible for lifting is-
- (a) Boom
 - (b) Counter-weights
 - (c) Jib
 - (d) Rotex Gear
23. The two types of pulleys in a hydraulic lift are-
- (a) fixed, fixed
 - (b) moveable, fixed
 - (c) moveable, moveable
 - (d) semi-movable, moveable
24. Rotary air compressor is best suited for-
- (a) Large quantity of air at high pressure
 - (b) Small quantity of air at high pressure
 - (c) Small quantity of air at low pressure
 - (d) Large quantity of air at low pressure
25. A centrifugal compressor works on the principle of-
- (a) Conversion of pressure energy into kinetic energy
 - (b) Conversion of kinetic energy into pressure energy
 - (c) Centripetal action
 - (d) Generating pressure directly
26. The clearance volume of air compressor is kept minimum because-
- (a) It allows maximum compression to be achieved
 - (b) It greatly affects volumetric efficiency
 - (c) It results in minimum work
 - (d) It permits isothermal compression
27. The main purpose of multi-stage air compression with intercooling is-
- (a) Increase in maximum temperature of cycle
 - (b) Expansion of refrigerant near to saturated liquid line
 - (c) Compression of refrigerant away from saturated vapour line
 - (d) Reduction in work input for same pressure ratio
28. Gas turbines for power generation are normally used-
- (a) to supply based load requirements
 - (b) to supply peak load requirements
 - (c) to enable starting of thermal power plant
 - (d) when other sources of power fail

29. The air-fuel ratio in gas turbines is of the order of-
- (a) 7 : 1 (b) 15 : 1
(c) 30 : 1 (d) 50 : 1
30. The pressure ratio in gas turbines is of the order of-
- (a) 2 : 1 (b) 4 : 1
(c) 6 : 1 (d) 12 : 1
31. Efficiency of gas turbine is increased by-
- (a) reheating (b) intercooling
(c) adding a regenerator (d) all of the above
32. Intercooling in gas turbine results in-
- (a) Increase in net output but decrease in thermal efficiency
(b) Increase in thermal efficiency but decrease in net output
(c) Increase in both thermal efficiency and net output
(d) Decrease in both thermal efficiency and net output
33. The creep in belt drive is due to-
- (a) Power fluctuation
(b) Thickness of the belt
(c) Unequal tension in tight and slack side of the belt
(d) Equal size of the pulleys
34. Which one of the following drives is used for transmitting power without slip?
- (a) Belt drives (b) Rope drives
(c) Cone pulleys (d) Chain drives
35. For non-parallel non-intersecting shafts, power can be transmitted with the help of-
- (a) Pair of helical gear (b) Pair of spur gear
(c) Pair of spiral gear (d) Oldham coupling
36. The function of a governor is to-
- (a) store energy and give up whenever required
(b) regulate the speed during one cycle of a prime mover
(c) decrease variation of speed
(d) adjust variation of speed by varying the input to the engine
37. Which of the following governor can possibly be an isochronous governor?
- (a) Watt governor (b) Hunting governor
(c) Porter governor (d) Hartnell governor
38. The term 'effort of governor' refers to-
- (a) Centrifugal force of balls
(b) useful power developed
(c) force acting on sleeve for given percentage change of speed
(d) minimum force required on sleeve for percentage change of speed

39. On a heat transfer surface, extended surfaces (fins) are provided to-
- (a) increase temperature gradient so as to enhance heat transfer
 - (b) increase turbulent inflow for enhancing heat transfer
 - (c) increase surface area to promote the rate of heat transfer
 - (d) decrease the pressure drop of the fluid
40. One ton of the refrigeration is-
- (a) the standard unit used in refrigeration problems
 - (b) the cooling effect produced by melting 1 ton of ice
 - (c) the refrigeration effect to freeze 1 ton of water at 0°C into ice at 0°C in 24 Hours
 - (d) the refrigeration effect to produce 1 ton of ice at Normal temperature and pressure condition
41. Which is the desirable physical property of a refrigerant?
- (a) Toxic
 - (b) Explosive
 - (c) Low boiling point
 - (d) High freezing point
42. The psychometric chart in air conditioning determines the-
- (a) wet bulb and dry bulb temperature
 - (b) psychometric temperature requirement
 - (c) saturation temperature and relative humidity
 - (d) moist air conditions
43. The comfort conditions in air conditioning system are defined by-
- (a) 22°C dry bulb temperature and 60% relative humidity
 - (b) 25°C dry bulb temperature and 100% relative humidity
 - (c) 20°C dry bulb temperature and 75% relative humidity
 - (d) 15°C dry bulb temperature and 80% relative humidity
44. Which type of transformer are used in arc welding?
- (a) Toroidal
 - (b) Auto-transformer
 - (c) Step up transformer
 - (d) Step down transformer
45. Too low welding current in arc welding would result in-
- (a) excessive piling up of weld metal, poor penetration, wasted electrodes
 - (b) excessive spatter, under cutting along edges, irregular deposits, wasted Electrodes
 - (c) too small bead, weak weld and wasted electrodes
 - (d) excessive piling up of weld metal, overlapping, without penetration of edges, wasted electrodes
46. For welding overhead joints in horizontal plane, following technique of gas welding is used:
- (a) forehand
 - (b) back hand
 - (c) straight hand
 - (d) inclined hand
47. A portable drilling machine is specified by-
- (a) the size of the job it can hold
 - (b) maximum diameter of drill it can hold
 - (c) spindle speeds and feeds
 - (d) maximum spindle travel
48. Grinding operation is used for-
- (a) removing material
 - (b) shaping
 - (c) dressing
 - (d) finishing

49. What is the principle of equipment selection in terms of material handling?
- For planning the material handling process to make handling work easy and simple
 - use gravity force for transporting material
 - select handling equipments as per the quantity and type of load
 - by eliminating unnecessary movement of material and equipment
50. Break-even analysis shows profit when-
- sales revenue > total cost (i.e. fixed cost + variable cost)
 - sales revenue = total cost (i.e. fixed cost + variable cost)
 - sales revenue < total cost (i.e. fixed cost + variable cost)
 - variable cost < fixed cost

PART - 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.

51. Table 1 shows the measured voltage for magnetic core balance test where LT 440V AC is injected in across HT terminals RY, YB and BR as shown. Considering HV side only, what are the condition required for the transformer core to be magnetically balance? From the measured voltages are the required conditioned fulfilled? (5)

Apply Single phase voltage 440V Across	Measured Voltage						Condition required
	HV Volts (Ph-Ph)			LV Volts (Ph-n)			
	RY	YB	BR	rn	yn	bn	
RY	424	469	190	79	90	37	
YB	155	420	259	29	79	49	
BR	168	356	423	32	68	79	

52. Insulation resistance of 10MVA, 33/11kV transformer is measured between HV and LV side and the result obtained is shown below: (5)
- 0.57 G'Ω after 10 minutes
 - 0.41 G'Ω after 1 minutes
 - 0.32 G'Ω after 30 seconds

Calculate the Polarization Index (PI) value and the Dielectric Absorption Ratio (DAR) value?

53. Draw schematic diagram of Wenner Array 4-point method for Earth Resistance measurement. What is the formula for calculating earth resistivity, ρ . What is the prescribed uniform distance between each probe compared to the depth of probe under ground? (5)

54. What are the criteria for selection site for Power Sub-Station? (5)
55. FIG. E shows a 100-50/1-1 Current Transformer (CT) circuit drawing where P1 & P2 denotes the primary winding terminals and S1, S2 & S3 denotes the secondary winding terminals. If the CT ratio is to be set at 100/1 ratio, which secondary terminals must be connected? For 33kV CT, what is the accuracy class acceptable for metering core? (5)

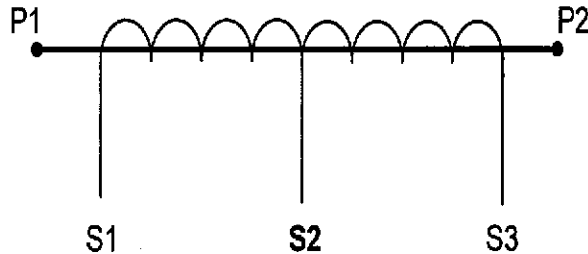
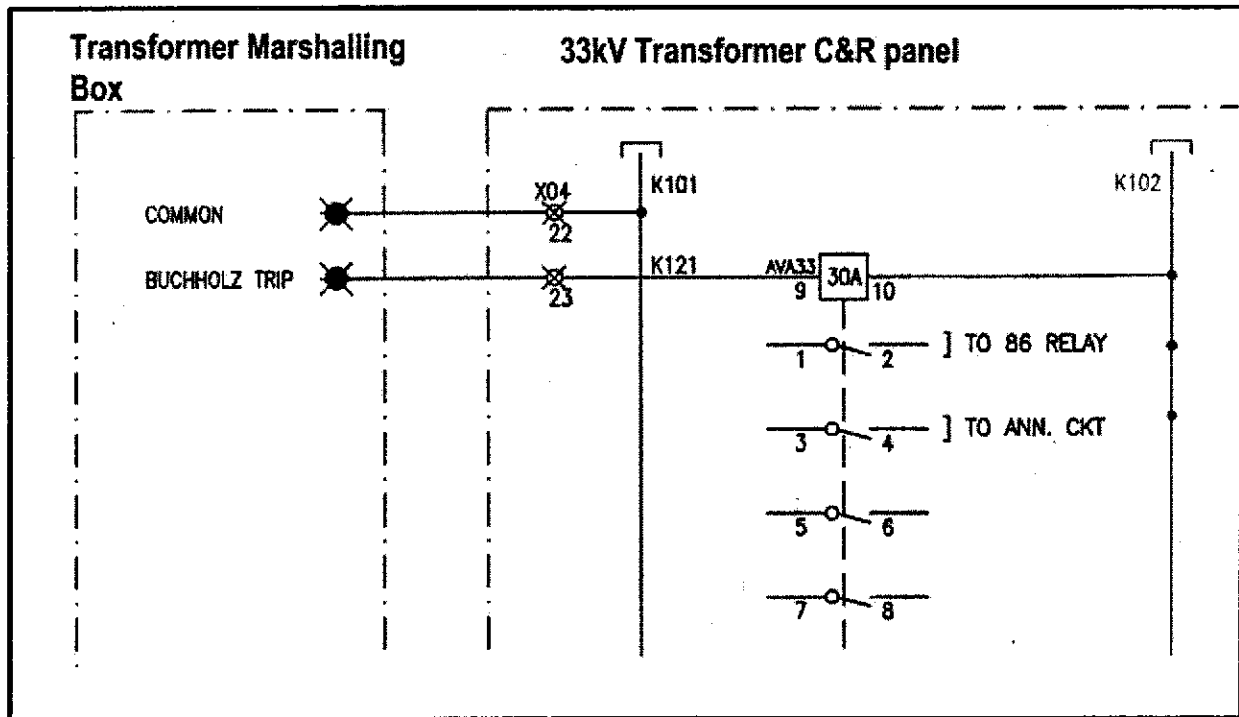


FIG. E

56. Figure below shows the nameplate of 100kVA, 11/0.415kV Distribution transformer. What is the normal tap position? What is the full form of ONAN? From the vector group how is the primary and secondary winding connected and what is the phase shift between the two? (5)

Rated power		100	kV-A	No. of phases	3
TRANSFORMER to specification EN (IEC) 60076-1					
Rated voltage [V]		Current [A]		Insulation level	
HV	11000 ± 2x2.5%	5.25		LI75 AC28	
LV	415	139.10		AC3	
Tap no.	HV voltage [V]	Connection symbol		Dyn11	
1	11550	Cooling		ONAN	
2	11275	Rated frequency		50 Hz	
3	11000	Short-circuit imp.		3.88 %	
4	10725	Load losses		1750 W	
5	10450	No-load losses		145 W	

57. Figure shows interconnection between Power Transformer Marshalling Box and 33kV Transformer Control & Relay for Buchholz protection. What is 86 relay stands for and what is its function? In the figure shown, what can cause 86 relay to operate? (5)



58. The external PT ratio is 33000/110V and external CT ratio is 400/1A. If the energy meter is calibrated for PT ratio 33000/110V, CT ratio -/1A then what will be the multiplying factor for the meter? (5)
59. Draw single line diagram 33kV Incoming line connecting 33kV Bus at Substation showing the following elements: (10)
- (a) Surge Arrestor
 - (b) Isolator with Earth Switch
 - (c) Current Transformer
 - (d) Circuit Breaker
