ELECTRICAL ENGINEERING

Paper : 1

Grade : V(B) Diploma

Full Marks – 200

Time – Three hours

The figures in the margin indicate full marks
for the questions.

Candidates are required to give their answers in
their own words as far as practicable.

GROUP – A   15×6=90

Answer *all* questions.

Each question carries 6 marks.

1. State the conditions for parallel operation of
   3-phase transformer.

2. Capacitor is used in single phase induction motor,
   but not in 3-phase induction motor. Explain.

3. Define 'armature reaction' in a d.c machine in
   short.

[Turn over

4. Derive the condition for maximum efficiency of a single-phase transformer.

5. Draw the vector diagram for 'under excited' and 'over-excited' condition of a synchronous generator.

6. Explain how use of capacitors improves the power factor of electric supply system.

7. Prove that transmission efficiency can be increased by increasing operating voltage.

8. In a 3-phase, 4-wire supply system, why fuse is not provided in neutral line ?

9. Calculate the inductance of two wire system of radius R carrying current I separated by distance D.

10. Write in short the 'Ferranti effect' in high voltage transmission line and the measures to reduce its effect.

11. Describe with necessary single line diagram making ON/Off from two different locations with the help of two-way switches.

12. Mention the maximum percentage of permissible voltage variation in M.V and H.V supply as per provision of I.E. Rules, 1956.

13. Two 230 volt, 40W watt and 230V, 100W bulbs are connected in series from a 230 volt source. Which bulb will glow brighter ?

14. Explain with diagram the method of connection of 5 numbers 1 ohm resistors to have a total 2Ω resistance.

15. Describe in short the method of controlling active and reactive power in a generating plant.

GROUP – B   40×2=80

Answer *all* the questions.

Each question is having four alternatives. Select and write down the correct answer in the answer book.

1. An electric motor converts

   (a) Electrical energy to mechanical energy

   (b) Mechanical energy to electrical energy

   (c) Heat energy to mechanical energy

   (d) None of the above.

2. In an inductive circuit

   (a) Current leads voltage

   (b) Current lags voltage

   (c) Current is in phase of voltage

   (d) None of these.

3. In a star connection system

   (a) Phase voltage and line voltage are equal

   (b) Phase voltage is 1.732 times of line voltage

   (c) Line voltage is 1.732 times of phase voltage

   (d) None of the above.

4. In lap winding of D.C machine the number of poles are equal to

   (a) Two   (b) Four

   (c) Six   (d) Number of parallel path

5. In a 3-phase balance load, the current in neutral is

   (a) $2 \times I_{ph}$ (b) $\sqrt{3} \times I_L$

   (c) Zero   (d) $2 \times I_L$

6. The maximum permissible value of earth resistance in domestic installations as per National Electric Code is

    (a) 1 ohm   (b) 2 ohm

    (c) 5 ohm   (d) 10 ohm

7. The dielectric strength of transformer oil used in EHT transformer should withstand

    (a) 11 KV for 1 min

    (b) 15 KV for 1 min

    (c) 20 KV for 1 min

    (d) 40 KV for 1 min

8. Eddy current loss is proportional to

    (a) Frequency

    (b) Square of frequency

    (c) Square root of frequency

    (d) None of the above.

9. Copper loss of a transformer can be found out by

    (a) Open circuit test

    (b) Short circuit test

    (c) Hopkinson test

    (d) None of the above.

10. There is no physical existence of poles in

(a) Universal motor

(b) D.C shunt motor

(c) Induction motor

(d) Synchronous motor

11. The gas used for arc extinction is gas-fill circuit breaker is

(a) Carbon dioxide

(b) Sulphur dioxide

(c) Carbon monoxide

(d) Sulphur Hexafloride

12. When the power factor is improved, current drawal for the same power will be

(a) More   (b) Less

(c) Same   (d) Zero

13. Moving iron instruments can be used in

(a) A.C circuit only

(b) D.C circuit only

(c) Both A.C and D.C circuit

(d) 50 Hz A.C circuit only.

14. Which one of the power plant has low running cost ?

    (a) Hydroelectric power plant

    (b) Thermal power plant

    (c) Gas thermal power plant

    (d) Nuclear power plant

15. Selection of slip-ring induction motor is made as its

    (a) Efficiency is more

    (b) Develops high starting torque

    (c) Cost is low

    (d) Power consumption is low

16. Economic conductor size in transmission line is derived from

    (a) Gauss law

    (b) Kelvin's law

    (c) Ampere law

    (d) Kirchoff's voltage law

17. The sag in a conductor of weight 'W' per length having tension 'T' for a span length 'L'

(a) $\frac{WL^2}{2T}$

(b) $\frac{WL}{T}$

(c) $\frac{WL}{8T}$

(d) $\frac{WL^2}{4T}$

18. If V_s is sending end voltage and V_R is receiving end voltage, the percentage regulation is

(a) $\frac{V_s - V_R}{V_R}$

(b) $\frac{V_s + V_R}{V_s}$

(c) $\frac{V_s - V_R}{V_s}$

(d) $\frac{V_s + V_R}{V_R}$

19. A high rating induction motor starts on ___ connection and runs on .... connected windings.

(a) Delta, Delta

(b) Star, Star

(c) Star, Delta

(d) Direct on line

20. When capacitors C_1 and C_2 are connected in series, total value of capacitance is

(a) $C_1 + C_2$

(b) $C_1 - C_2$

(c) $\frac{C_1 + C_2}{C_1 \times C_2}$

(d) $\frac{C_1 \times C_2}{C_1 + C_2}$

21. The voltage across individual identical discs in a string of suspension insulators is different due to

   (a) Shunt capacitance to ground

   (b) Series capacitance

   (c) Leakage current

   (d) Shunt inductance

22. Which one of the following statement is correct when P is number of poles ?

   (a) Electrical degree $= \dfrac{P}{2} \times$ mechanical degree

   (b) Electrical degree $= P \times$ mechanical degree

   (c) Mechanical degree $= \dfrac{P}{2}$ electrical degree

   (d) Mechanical degree $= P \times$ electrical degree

23. Flux in magnetic circuit is analogous to ...... in electrical circuit.

   (a) E. M. F

   (b) Current

   (c) Resistance

   (d) Impedance

24. Ohm's law is represented by

(a) $I = \dfrac{V}{R}$

(b) $I = \dfrac{R}{V}$

(c) $I = VR$

(d) $I = \dfrac{V^2}{R}$

25. The electrical gear is essential in large electrical installations but not in small domestic installation.

(a) Main switch

(b) Distribution box

(c) Bus bar

(d) Cut-out

26. The speed of a 2-pole, 50 Hz synchronous motor will be

(a) 3000 rpm

(b) 6000 rpm

(c) 9000 rpm

(d) 12000 rpm

27. Tap changing in a transformer is made for

(a) Active power control

(b) Voltage control

(c) Current control

(d) Frequency control

28. Where $X_L = X_C$ in a LCR series circuit, the circuit is said to be

 (a) Partly resistive

 (b) Inductive

 (c) Capacitative

 (d) Resonant

29. In transmission line design, effect of shunt capacitance is neglected in case of

 (a) Long line

 (b) Medium line

 (c) Short line

 (d) Irrespective of length of line

30. Ring main distribution system is preferred to radial system because

 (a) Less expensive

 (b) High power factor

 (c) Voltage drop is less

 (d) All of the above.

31. The insulation strength of EHV system generally governed by

(a) Lighting over-voltage

(b) Switching over-voltage

(c) Power frequency over-voltage

(d) Power supply through the line

32. A, B, C, D constants are related to transmission lines as

(a) AD − BC

(b) $\frac{A}{D} + \frac{B}{C} = 1$

(c) AD − BC = 1

(d) $\frac{ABCD}{2}$

33. The component related to hydroelectric power plant only is

(a) Turbine

(b) Alternator

(c) Nozzle

(d) Penstoc

34. An universal motor is

   (a) 1-phase induction motor

   (b) Synchronous motor

   (c) D.C series motor

   (d) D.C shunt motor

35. Maximum permissible variation of declared supply frequency as per I. E. rules, 1956 is

   (a) $\pm 10\%$ (b) $\pm 5\%$

   (c) $\pm 3\%$ (d) $\pm 1\%$

36. A turn in a winding consists of

   (a) Single conductor

   (b) Two conductors

   (c) Four conductors

   (d) Six conductors

37. In a pure resistive load

   (a) There will be no reactive power

   (b) Magnitude of active and reactive power is same

   (c) Active power is greater than reactive power

   (d) Reactive power is greater than active power

38. Back emf of a D.C shunt motor is proportional to

(a) Aplied voltage

(b) Armature current

(c) Motor speed

(d) Field current

39. String charts are used to find out

(a) Span length

(b) Location of towers

(c) Location of insulators

(d) Sag and tension

40. The purpose of capacitor in 1-phase fan is to

(a) Increase the speed

(b) Protect fan against faults

(c) Produce a phase shift

(d) Control the speed

GROUP – C

$5 \times 6 = 30$

Answer *all* the questions.

Each question carries 6 marks.

1. A single phase 33 kV overhead transmission line delivers 1100 kW load at 0.8 p.f. Total impedance of the line is $(10 + j\ 15)$ ohm. Determine

   (a) sending end voltage and

   (b) transmission efficiency.

2. A hydro project is supplied from a reservoir of capacity 5000000 cu. mt at a head of 200 mt. Find out the total energy available in kNH if the overall efficiency is 75%.

3. A 4-pole, 50 Hz induction motor is running at 1455 rpm. Find the frequency of the induced voltage at rotor circuit.

4. A shunt generator supplies 500A at 250V terminal voltage. Armature resistance is 0.4 ohm and the field resistance is 50 ohm. Find out generated emf.

5. A 1-phase transformer has 400 turns and 1000 turns in primary and secondary winding respectively. The overall cross-sectional area of the core is 60 sq.cm. If the primary winding is connected to 50 Hz, 500V supply, calculate the maximum flux density in the core.