

ELECTRICAL ENGINEERING

Paper - I

Grade : V(A)-Degree

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 carrying six marks.

1. Define electric flux density. Derive Gauss's law from the definition of the same.
2. State and explain Ampere's circuital law. Does it hold good when the current distribution is non-symmetric?
3. Describe displacement current with an example. Distinguish between conduction current and displacement current.

[Turn over

4. Enumerate basic differences between Faraday's law and Lenz's law of electromagnetic induction.
5. State and explain the significance of four basic parameters in a transmission line.
6. "A perfect conductor can not contain an electrostatic field within it". - Justify the statement.
7. State about superconductors and superconductivity. Can you find any application of superconductivity in electrical engineering?
8. Describe constant voltage source and constant current source with neat circuit diagrams for the both.
9. What is magnetic circuit? Find out an expression for reluctance in magnetic circuit.
10. Describe the principle of operation of Permanent Magnet Moving Coil (PMMC) measuring instruments. State their advantages and disadvantages.
11. Describe with neat diagram, the expression of the output parameter in an Anderson bridge.
12. What type of sensors are used in digital power meter? Explain the operation of the sensors during power measurement.

13. Describe Hurwitz stability criterion for an n^{th} order system.
14. What are the root locus concept in a control system? How can you determine the root for a specified open loop gain?
15. Clearly describe the basic principle of hydraulic feedback system.

GROUP - B

40×2=80

Answer *all* questions.

Each carrying *two* marks.

Each question has four alternative answers. Select and write down the best alternative in your answer book.

1. Two point charges of similar polarity are placed apart. Which of the following statement is correct?
 - (a) The mutual force is repulsive
 - (b) The force varies as the square root of the distance between them
 - (c) The force does not depend on the medium
 - (d) The charges will try to collide with each other.

S/TR/TES/E-I/V(A)/13 (3)

[Turn over

2. Electrostatic field is
- (a) conservative
 - (b) linear
 - (c) solenoidal
 - (d) None of these
3. Electrostatic field is directed from
- (a) Higher potential to lower potential point
 - (b) Lower potential to higher potential point
 - (c) Follows a sinusoidal path
 - (d) Remain fixed all along between the points.
4. Which is not an example of convection current?
- (a) A moving charged belt
 - (b) An electron beam in a TV tube
 - (c) Electron current flowing through a copper plate
 - (d) Electron movement in a vacuum tube.
5. What happens when a steady potential difference is applied across the ends of a conductor?
- (a) All electrons move with a constant acceleration
 - (b) All electrons move with a constant velocity
 - (c) The random electron motion will, on the average be equivalent to a constant velocity
 - (d) All electrons will follow a zig-zag path

6. The formula $R = \rho l/A$ is applicable to :
- (a) Thin metal wire
 - (b) A conductor of hollow sphere
 - (c) A flat conducting strip with unequal cross-section
 - (d) None of these
7. What can act as a superconductor ?
- (a) Gold
 - (b) Silver
 - (c) Lead
 - (d) Tungsten filament
8. Which of the following statement is correct ?
- (a) Electric field is always perpendicular to the conductor surface
 - (b) Electric field is tangential to the conducting surface
 - (c) Electric field resides only within the conductor
 - (d) None of these
9. Ceramics are basically
- (a) Semiconductors
 - (b) Insulators
 - (c) Conductors
 - (d) Polymers

10. Polarisation within the dielectric occurs along
- (a) The same direction of the applied field
 - (b) The opposite direction of the applied field
 - (c) Independent of the direction of applied field
 - (d) None of these
11. The unit of reluctance is
- (a) Weber
 - (b) Henry
 - (c) $(\text{Henry})^{-1}$
 - (d) None of these
12. What is not a source of static magnetic field?
- (a) A permanent magnet
 - (b) A d.c current in a wire
 - (c) An accelerated charge
 - (d) A charged disk rotating at a constant speed
13. Which of these statements is not characteristic of a static magnetic field?
- (a) It is solenoidal
 - (b) It is conservative
 - (c) Magnetic field lines are always closed
 - (d) None of these

14. Magnetic levitation is a phenomenon associated to
- (a) Electromagnetic induction
 - (b) Super conductivity
 - (c) Conservation of energy
 - (d) None of these
15. The nature of force acting between two thin parallel wire carrying current along opposite direction is :
- (a) Attractive and perpendicular to the line
 - (b) Repulsive and perpendicular to the line
 - (c) Parallel to the lines
 - (d) Zero
16. What is the unit of magnetic charge ?
- (a) Coulomb
 - (b) Ampere
 - (c) Ampere-meter
 - (d) Ampere-meter²



17. What is the value of reactance at resonance in a parallel L-C circuit?

- (a) Infinite
- (b) Zero
- (c) Positive
- (d) Negative

18. The value of Q-factor in a parallel R-C circuit is

- (a) $1/WCR$
- (b) WCR
- (c) $1/2\pi RC$
- (d) None of these

19. In the series R-L-C circuit, the total impedance below resonance frequency is

- (a) Positive
- (b) Negative
- (c) Zero
- (d) Infinite

20. In parallel R-L-C resonant circuit, what will happen when $R_L = R_C = \sqrt{L/C}$, R_L and R_C being the resistance of the inductor and capacitor respectively.

- (a) Resonance does not occur
- (b) Resonance occurs at a single frequency
- (c) Resonance occurs at the frequencies
- (d) None of these

21. In the complex frequency, the real part is expressed as

- (a) radian/sec
- (b) cycles/sec
- (c) Neper/sec
- (d) None of these

22. A differentiator circuit means

- (a) An R-L circuit with high time constant when output is taken across R
- (b) An R-C circuit with small time constant when output is taken across R
- (c) An R-C circuit with high time constant when output is taken across C
- (d) None of these

23. In an electrical network, the number of link branches will not depend on

- (a) Number of tree branches
- (b) Number of total branches
- (c) Number of nodes
- (d) The current path



5/TR/TES/E-I/V(A)/13 (9)

24. In nodal analysis of electrical network
- (a) Impedance matrix is used
 - (b) Admittance matrix is used
 - (c) Hybrid parameter matrix is used
 - (d) ABCD matrix is used
25. Thevenin's theorem will hold good for
- (a) D.C electrical network only
 - (b) A.C electrical network only
 - (c) For both d.c and a.c electrical networks
 - (d) None of these
26. Megger is used to measure
- (a) Very high current
 - (b) Very high voltage
 - (c) Very high resistance
 - (d) Very high impedance
27. A parallel wire transmission line will have no distortion in the following signal when
- (a) $R = G = 0$
 - (b) $RC = GL$
 - (c) $RL = GC$
 - (d) None of these

28. VSWR of a transmission line will depend on

- (a) The structure of the line
- (b) The length of the line
- (c) The separation between the lines
- (d) None of these

29. Maxwell-Wien bridge is used to measure

- (a) Inductance
- (b) Dielectric loss
- (c) Capacitance
- (d) Phase angle

30. The most useful a.c bridge to compare capacitances of two capacitor is

- (a) De-Sauty
- (b) Schering
- (c) Wien parallel
- (d) Wien series

31. Anderson bridge is a modification of bridge

- (a) Owen
- (b) Hay
- (c) Maxwell-Wien
- (d) De-Sauty



32. The capacitance of a capacitor is not influenced by
- (a) Plate thickness
 - (b) Plate area
 - (c) Plate separation
 - (d) Nature of the dielectric
33. A KWh meter can be classified as an instrument with nature of
- (a) Digital
 - (b) Deflecting
 - (c) Recording
 - (d) Indicating
34. The moving system of an indicating type of electrical instrument is subjected to
- (a) A controlling torque
 - (b) A damping torque
 - (c) A deflecting torque
 - (d) All of these
35. The most efficient form of damping employed in electrical instruments are
- (a) Fluid friction
 - (b) Air friction
 - (c) Eddy currents
 - (d) All of these

36. Moving iron measuring instruments can be used to measure
- (a) Direct voltage and current
 - (b) Alternating voltage and current
 - (c) Radio frequency current
 - (d) Both (a) and (b)
37. PMMC ammeter has uniform scales because
- (a) of eddy current damping
 - (b) they are spring controlled
 - (c) their deflecting torque varies as current
 - (d) both (b) and (c)
38. The function of a pressure gauge is to convert from
- (a) Pressure to voltage
 - (b) Pressure to current
 - (c) Pressure to displacement
 - (d) None of these
39. The stability of a feedback control loop can be known from
- (a) The locations of poles and zeroes
 - (b) The location of the poles only
 - (c) The location of the zeroes only
 - (d) None of these

40. A signal flow graph approach is applied
- To deal with complicated control system in simple manner
 - It increases the processing time
 - It involves tremendous mathematical process
 - None of these

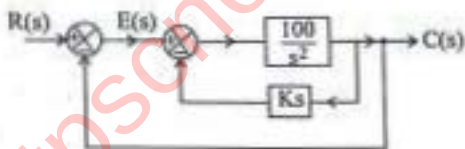
GROUP - C

5×6=30

Answer all questions.

Each question carries six marks.

- A low inertia plotter can be represented by the following block diagram.



Calculate the value of velocity gain K such that the system is non-oscillatory, yet has the lowest possible settling time to step input.

- A liquid resistor consists of two concentric metal cylinders of length 60 cm each and diameters 35 cm and 20 cm. Water resistivity is 8 Kilo Ohm. cm between them.

Calculate the resistance of the liquid resistor.

5/TR/TES/E-UV(A)/13 (14)

3. The torque of an ammeter varies as an square of the current through it. If a current of 5 Amp produces a deflection of 90° , what deflection will occur for a current of 3Amp when the instrument is (i) spring controlled (ii) gravity controlled?
4. The field winding of a d.c electromagnet is wound with 960 turns and has resistance of 50 ohm when the exciting voltage is 230V, the magnetic flux linkage with the coil is 0.005 Weber. Calculate the self inductance of the coil and the energy stored in the magnetic field.
5. A coil has a time constant of 1 second and an inductance of 8 Henry. If the coil is connected to a 100V d.c source, find out
- (a) The rate of rise of current at the instant of switching.
 - (b) The steady state value of the current
 - (c) The time taken by the current to reach 60% of the steady value of the current.

