PART - II

Subject: Electrical Engg. - I

TO BE FILLED BY THE CANDIDATE

Roll No. (In words)

Name of the candidate

Date of Birth (DD/MM/YYYY)

Father's Name

Signature of the candidate

Date of Examination

Invigilator must check the Roll No. and Photo ID. of the candidate, then Sign. here:

TO BE FILLED BY INVIGILATOR

If candidate found using unfair means then Invigilator should fill up this bubble with black/blue ball pen & report to the Centre Superintendent:

[Blank]
IMPORTANT NOTES
महत्वपूर्ण नोट

(A) Please fill up the OMR Sheet of this Question-Answer Booklet properly before answering.

(B) The question paper is divided into different unit and parts. The number of questions to be attempted and their marks are indicated in each unit and parts.

(C) Attempt answers either in Hindi or English, not in both. For Language Papers, answer in concerned language and script, unless directed otherwise to write in Hindi or English specifically.

(D) The candidates should not write the answers beyond the prescribed limit of words; failing this, marks will be deducted.

(E) Please write answers only in the prescribed space of booklet. Do not write any mark of identity inside the Answer Script (including Paper for rough work) i.e. name, address, telephone number, Name of God etc. or any irrelevant words other than the answer of question. Such act will be treated as unfair means. The Commission may also deduct 5 marks from the marks obtained, if Roll Number is not filled correctly on the O.M.R. Sheet.

(F) Candidates are directed that they should not write (answer) out side the border line in every page. Answer written out side the border line will not be checked by the Examiner.

(G) If there is any sort of ambiguity/mistake either of printing or factual nature then out of Hindi and English version of the question, the English version will be treated as standard.

(H) It should be ensured that the Question-Answer Booklet is provided in a sealed envelope to the candidate.

(I) Candidate should fill up all desired details on this attached OMR sheet of Question-Answer Booklet with blue ball pen point. Please ensure that this OMR Sheet is not torn or damaged.

(J) This OMR Sheet consists of Two parts, in which some information is pre-printed; remaining details have to be filled by the candidate.

(K) If the Question-Answer Booklet is torn or not printed properly, bring it to notice of invigilator and change the Question-Answer booklet, otherwise the candidate will be liable for that.

Special Notes:
If there is any wrong information filled by the candidate or any attempt is made to damage it or any marking as identification is done, then his candidature for the entire examination shall be rejected by the commission, for which he will be liable.
PART – A

Note: Attempt all questions. Answer the following questions in 15 words each. Each question carries 2 marks.

1. A network contains linear resistors, which are connected in series across an ideal voltage source. If all the resistances are halved and the voltage is doubled, then what will be the voltage across each resistor?

2. Write the characteristic equation of the series RLC circuit.

3. Two mutually coupled coils of inductances 1.8 mH and 5 mH has mutual inductance of 2.5 mH. Find the coupling coefficient between the two coils.

4. Suppose length of a resistor is reduced to half. What will be the resistivity of new resistor?
5. Compute the Laplace transform of \( f(t) = t \sin h(10t) \).

6. A series LCR type band stop filter has \( R = 1.5 \, k\Omega \), \( L = 140 \, mH \) and \( C = 300 \, pf \), find the bandwidth.

7. A charged hollow sphere is suspended in a uniform electric field of \( E \), then what will be the field strength inside the sphere?

8. The position of a point in cylindrical co-ordinate is specified by \( (4, \, 2\pi/3, \, 3) \). What is the location of the point in spherical co-ordinates?
9. What are the main two factors which destroy the super conductivity?


10. What happens when the temperature of a magnetic material is raised above the Curie point?


11. In piezoelectric crystals, the electricity is generated by what mechanical action?


12. Write the two disadvantages of controlling the speed of induction motor by changing rotor circuit resistance.


13. A 40 kVA transformer has core-loss of 450 W and full-load copper loss of 800 W. If the power factor of the load is 0.8, calculate the full load efficiency.

14. Why distributed windings and short pitch (chorded) windings are employed in AC machines?

15. What is used to make the ceiling fan motor a self start?

16. How the thermal efficiency of coal fired steam plant can be increased?
17. What is an infinite bus in power system?

18. What is meant by dynamic response in load frequency control?

19. Define the Surge Impedance Loading (SIL) of a transmission line.

20. An overhead transmission line with surge impedance of 400 ohm is terminated through a resistance R. For what value of R the surge travelling over would not suffer any reflection?
PART - B

Note: Answer all the following questions in 50 words each. Each question carries 5 marks.

21. Enumerate the difference between transient response and steady state response of a circuit.

22. Calculate the range of K for which the system given by following characteristic equation is stable.

\[ S^3 + 7S^2 + 10S + 10K = 0 \]
23. For the network shown in figure, obtain the transfer functions $G_{21}(s)$ and $Z_{21}(s)$ and the driving point impedance $Z_{11}(s)$.
24. Given a vector function \( \mathbf{E} = a_x y + a_y x \) evaluate the line integral \( \int \mathbf{E} \cdot d\mathbf{l} \) from \( P_1(2, 1, -1) \) to \( P_2(8, 2, -1) \); along the parabola \( x = 2y^2 \).

25. For aluminium conductor the conductivity is \( \sigma = 3.82 \times 10^7 \text{ S/m} \) and the mobility of electrons \( \mu_e = 0.0014 \text{ m}^2/\text{V-second} \). If the drift velocity is \( 5.3 \times 10^{-4} \text{ m/second} \), find the current density and electric field intensity.
26. A pure silicon bar of 1 cm length, and 1 mm$^2$ cross-section area at room temp. of 27 °C has intrinsic carries concentration equal to $1.5 \times 10^{16}$/m$^3$. The electron and proton mobility is 0.13 m$^2$/V-second and 0.05 m$^2$/V-second respectively. Find the conductivity of the silicon material.
27. Enumerate the various tests conducted on a transformer and purpose of these tests.

28. A single circuit 3-φ, 50 Hz transmission line consists of 3-conductors arranged in triangular fashion. The GMR and GMD of the lines are 0.002473 m and 5.848 m respectively. Find the inductance per kilometre of the line.
29. A 6-pole 50 Hz induction motor has a rotor resistance of 0.3 Ω and maximum torque of 180 Nm, while it runs at 840 rpm. What is the torque developed by the motor at 5.5% slip?

30. Compare hydro, thermal and nuclear power stations on the basis of initial cost, running cost, efficiency and maintenance cost.
31. State why P-F and Q-V control loops can be treated as independent (non-interactive) in load frequency control.

32. Why circuit breaker SF₆ (Sulphur Hexa Fluoride) is widely used?
PART – C

**Note**: Answer the following questions in **100** words each. Each question carries **20** marks.

33. State the Thevenin’s theorem and write the various steps to obtain Thevenin’s voltage and Thevenin’s resistance. In the circuit given, find out the current flowing through the 3 Ω resistor using Thevenin’s theorem.
34. Discuss the Maxwell’s equation in integral form.

An area of 0.75 m² in the Z = 0 plane is enclosed by a filamentary conductor. If the magnetic field B is given as \( B = 0.05 \cos \left( \frac{10^3 \hat{y} + \hat{z}}{\sqrt{2}} \right) \) tesla, determine the induced voltage.
35. Draw the symmetrical wave form for the armature short circuit current for a 3-φ synchronous generator. Indicate the three periods into which its envelope may be divided.

A 3300/230 V, 50 kVA transformer is found to have impedance of 4% and copper loss of 1.8% at full load. Find its percentage reactance and also the Ohmic values of resistance, reactance and impedance as referred to primary. What would be the value of primary short circuit current, if primary voltage is assumed constant?
36. Under the study of single area system, find out the steady state change in frequency using final value theorem.

A 125 MVA turbo-alternator operates on full load at 50 Hz. A load of 50 MW is suddenly reduced on the machine. The steam valves to the turbine commence to close after 0.5 s due to the time lag in the governor system. Assuming the inertia to be constant, \( H = 6 \text{ kW-S per kVA} \) of generator capacity, calculate the change in frequency that occurs in this time.
37. (a) Determine the current transformer (CT) ratios for differential protection of a threephase, Δ-Y connected, 15 MVA, 33/11 kV transformer such that the circulating current in the transformer, Δ (Delta) does not exceed 5 ampere.
(b) Find the ABCD constants of a π circuit having a 600 ohm resistor for the shunt branch at the sending end, a one kilo ohm resistor for the shunt branch at the receiving end and an 80 ohm resistor for the series branch.