QDB – 34

ELECTRICAL ENGINEERING

Time : 3 Hours]   [Total Marks : 200

Instructions : 1) The question paper has been divided into **three** parts, "**A**", "**B**" and "**C**". The number of questions to be attempted and their marks are indicated in **each** part.
2) Medium of question paper is "**English**". Please write in **English language only**.
3) Answer to all questions of each part should be written continuously in the script and should not be mixed with those of other parts. In the event of candidate writing answers to questions in a part different to the one which the question belongs, the question shall not be assessed by the examiner.
4) The candidate should write the answer within the limit of words prescribed in the parts "**A**", "**B**" and "**C**".

<div align="center">PART – A   Marks : 40</div>

Instructions : 1) Question No. **1** to **20**.
2) Attempt **all 20** questions.
3) **Each** question carries **2** marks.
4) Answer should be given approximately in **20** to **30** words.

1. State whether connections of circuit shown in Fig. 1 is valid or not ?
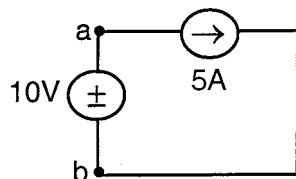

Fig. 1

2. Sketch the profile of current and impedance with frequency in a series RLC circuit.

3. Write the expressions for time constant of RC and RL circuits. What does a large value of time constant indicates ?

4. What is Ferranti effect ?

5. What is the necessity of a electromagnetic ballast in a Fluorescent lamp ?

6. Why Short Circuit Ratio (SCR) of a 3 phase alternator should be high ?

7. Under what condition a synchronous motor draw leading current from 3 phase supply ?

P.T.O.

8. What is transient stability ?

9. Why d.c. series motors are preferred for electric traction applications ?

10. Define string efficiency of insulators.

11. Why is PWM switching used in investors control ?

12. Snubber circuit is used to protect SCR's against $\frac{dv}{dt}$ and $\frac{di}{dt}$ effects ? Out of the two effects, which is more dangerous to SCRs ?

13. Write two advantages of feedback systems over non-feedback control systems.

14. A moving coil instrument has a full scale deflection of 10 mA, when the voltage across its terminals is 50 mV. Determine the value shunt resistance, so that the full scale deflection is 10A.

15. State the purpose of program counter in the 8085 microprocessor.

16. State Gauss's law in electromagnetism.

17. Which types of materials are suitable for dielectric heating ?

18. What is the disadvantage of a proportional (p) controller ?

19. What is effect of increasing forward path gain of a system ?

20. Biasing of MOSFET by fixing V_{GS} is not a good technique, why ?

<div align="center">PART – B</div> Marks : 60

Instructions : 1) Question No. *21* to *32*.
2) Attempt *all 12* questions.
3) *Each* question carries *5* marks.
4) *Answer should be given approximately in 50 to 60 words.*

21. Use node voltage method of circuit analysis to find the branch current i_1, i_2 and i_3 in the circuit shown in Fig. 2.
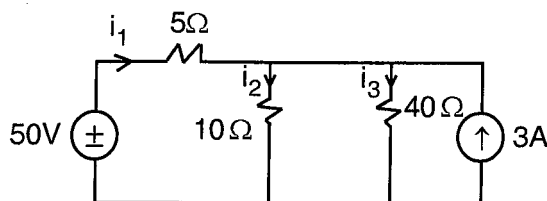

Fig. 2

22. Draw the circuit of a step-up chopper and derive expression of output voltage in terms of input d.c. voltage.

23. What are bundled conductors and what are their advantages ?

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24. A d.c. shunt motor runs at 500 rpm at no load with 200 V input. The armature resistance in 0.5Ω and the armature current is 30A. What resistance must be inserted in series with armature so that the speed is reduced to 300 rpm, while maintaining same armature current ?

25. What are the two types of corona discharge ? Why do they occur either in positive half cycle or negative half cycle ?

26. A strain gauge of nominal resistance of 250Ω has a gauge factor of 02, when a load is applied, the change in resistance is 0.012Ω. What is the change in length of beam to which the gauge is bonded. Assume length of beam 0.1m ?

27. Determine the transfer function C/R of the system, whose signal flow graph is shown in Fig. 3.
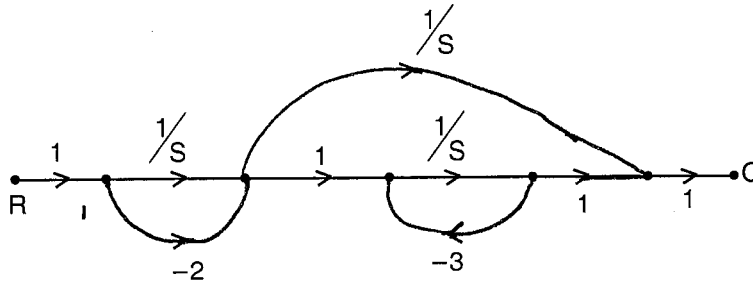

Fig. 3

28. Find the Laplace transform of the signal shown in Fig. 4 using waveform synthesis.
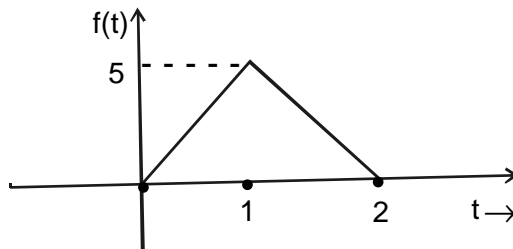

Fig. 4

29. What are the control signals in 8085 microprocessor ? How are they generated ? Draw neat schematic diagram.

30. What is meant by equipment grounding ? In resistance grounding, what is the criteria of selecting the value of resistor ?

31. Explain the principle of Current Transformer (CT) with help of neat circuit diagram. Why CTs are not operated, with open circuit secondary, while the primary is energised ?

32. With help of neat circuit diagram, and waveforms, explain operation of single phase fully controlled bridge rectifier feeding highly inductive load. Derive an expression for d.c. output voltage (V_o) in terms of rms supply voltage (V_s) and firing angle of SCRs (α).

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PART – C

Marks : 100

Instructions : 1) *Questions **33** to **39**.*
2) *Answer **any 5** out of 7 questions.*
3) ***Each*** *question carries **20** marks.*
4) *Answer should be given approximately in **200** words.*

33. A unity feedback system is characterized by an open loop transfer function

    $G(s) = \dfrac{K}{s(s+10)}$. Determine the value of gain K so that the system will have a damping ratio of 0.5. For this value of K determine the settling time for 5% criterion and peak overshoot for unit step response.

34. The fuel inputs per hour of power plants 1 and 2 are given as :

    $F_1 = 0.22\, P_1^2 + 50\, P_1 + 150$ Rs. per hour

    $F_2 = 0.24\, P_2^2 + 30\, P_2 + 200$ Rs. per hour

    Determine economic operating schedule. The maximum and minimum loading on each unit is 100 MW and 30 MW and the demand is 180 MW. If the load is equally shared what is the extra cost of operation ? Neglect transmission loss.

35. Draw the circuit diagram of a Wien's Bridge and derive condition for a balance of the bridge and explain how frequency is measured using this bridge.

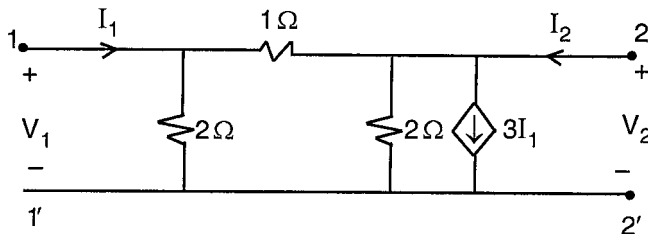36. Find z parameters of the two part network shown in Fig. 5.

Fig. 5

37. a) Considering electric field intensity defined as

    $\overline{E} = E_x(z,t)\,\hat{i}_x = 10 \cos(6\pi \times 10^8 t - 2\pi z)\,\hat{i}_x$, determine the value of $\overline{B} = B_y(z,t)\,\hat{i}_y$, V/m.

    b) A vector field $\overline{E}$ is given in cylindrical co-ordinate by

    $\overline{E} = \dfrac{1}{r^2}\left(\cos\phi\,\hat{i}_r + \sin\phi\,\hat{i}_\phi\right)$. Express the vector $\overline{E}$ in Cartesian co-ordinates as $\overline{E} = E_x\hat{i}_x + E_y\hat{i}_y + E_z\hat{i}_z$ and then determine $\overline{E}$ at $(1, \sqrt{3}, -4)$.

38. With help of neat diagrams, discuss the major components in a HVDC converter station. What are the different types of links used in HVDC transmission ?

39. Develop a state variable representation of an armature controlled DC motor. Assume armature current (i_a), angular displacement of shaft (θ) and angular velocity (ω) of the shaft as the state variables. Assume armature resistance (R_a) and inductance (L_a).

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