

2016

ELECTRICAL ENGINEERING-PAPER-I

Time Allowed : 3 Hours

Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in English or in Bengali but all answers must be in one and the same language.

GROUP - A

Answer any three questions

1. (a) A battery having an e.m.f. of 110 V and an internal resistance of 0.2Ω is connected in parallel with another battery with e.m.f. of 100 V and a resistance of 0.25Ω . These two in parallel are placed in series with a regulating resistance of 5Ω and connected across 220 V mains as shown in Fig.-1. Calculate the magnitude and direction of the current in each battery and the total current taken from the main supply. Apply only Kirchhoff's Laws.

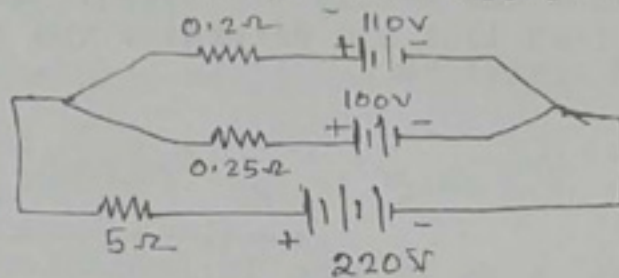


Fig. - 1

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- (b) Find the value of R in Fig.-2 such that the power supplied by the 100 V source to the network is the same to the power supplied by the 5-A source.

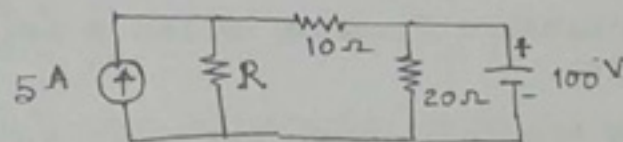


Fig. - 2

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- (c) What are the conditions for balanced 3-phase load when it is supplied from balanced 3-phase source ?

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2. (a) If sequence $f_1(n)$ is a periodic sequence with period N and it is also periodic with $2N$. Assume that $S_1(K)$ is the DFT of $f_1(n)$ with period N and $S_2(K)$ is DFT of $f_1(n)$ with period $2N$. Determine $S_2(K)$ in terms of $S_1(K)$.

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- (b) Find the Laplace transform of the triangular pulse shown in Fig.-3.

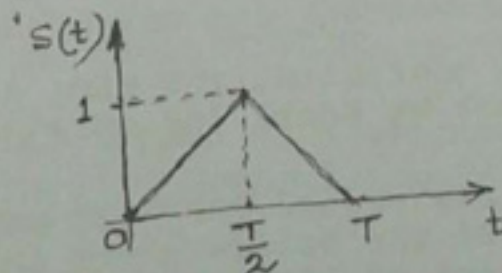


Fig. - 3

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- (c) Write down Poisson's equation and Laplace equation in polar co-ordinate form.

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P. T. O.

3. (a) Calculate the work ΔW required to move the cart along the Circular path from point A to B as shown in Fig.-4, if the force field is $F = 3XYU_x + 4XYU_y$. Cartesian coordinates are preferred.

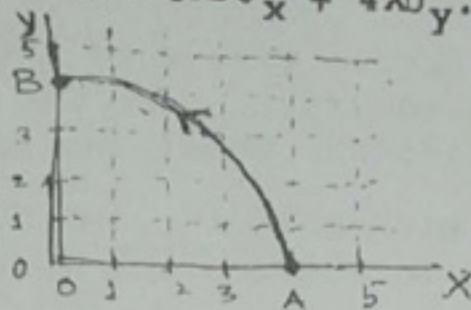


Fig. - 4

- (b) When two identical coupled coils are connected in series, the inductance of the combination is found to be 80 mH. When the connections to one of the coils are reversed, a similar measurement indicates 20 mH. Find the coupling coefficient between the coils.
- (c) With equivalent circuit and characteristic explain the working principle of MOSFET.
4. (a) Fig.-5 shows the design of voltage divider bias method. Draw the d.c. load line and determine the operating point for a germanium transistor.

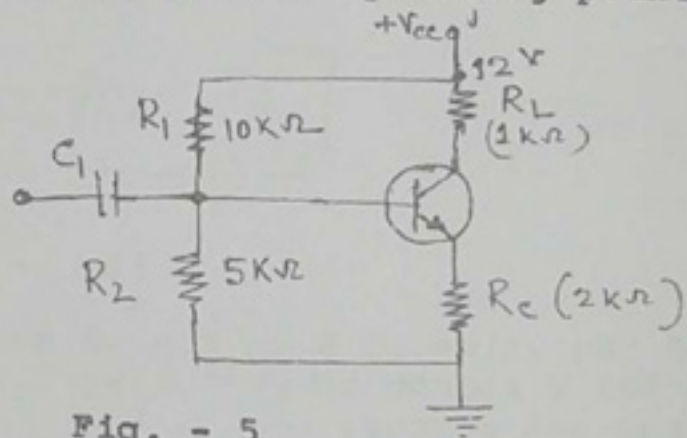


Fig. - 5

- (b) With schematic diagram write a note on single-ended power amplifier.
- (c) Discuss the full-wave rectifier and wave form using four diodes.
5. (a) How can a RS flip-flop can be constructed using (i) two NAND and (ii) four NAND gates. Explain its working principle and write the truth table in case of (i).
- (b) Using Boolean expressions, prove that -

$$A.B + \overline{A}.C + A.\overline{B}.C.(A.B.+C) = 1$$
- (c) Explain the difference between ROM and RAM.

GROUP - B

Answer any two questions

6. (a) Show that for a.c. operation, the time constants of the shunt and the ammeter must be equal for an accurate reading at all frequencies.
- (b) A strain gauge of resistance 200Ω and gauge factor 2 is connected in the arm AB of the bridge shown in Fig.-6. The resistance of arms CD and DA are of 100Ω each. R_2 is adjusted for balance under unstrained condition. The supply voltage to the bridge is of 10 V and counted across terminals BD. Determine the output

voltage when a detector of infinite resistance is connected across output terminals and the strain is of 500 microstrain. Determine the current flowing through the detector for a strain of 500 microstrain, if the resistance of the detector is 250Ω .

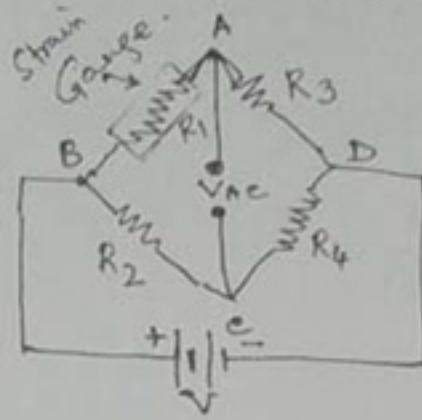


Fig. - 6

(c) Describe the operation of an LVDT.

7. (a) Sketch the Bode plot for the open-loop transfer function for the unity feedback system given below and assess stability.

$$G(s) = \frac{50}{(s+1)(s+2)}$$

- (b) Obtain the state transition matrix in the form e^{At} for the system, $\dot{X} = A X$

where, $A = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix}$ and $x_1(0) = 1$, $x_2(0) = 1$.

- (c) Write the Z-transform of $\exp(-t)$ sampled at a frequency of 10 HZ.

8. (a) Draw the root loci of open-loop transfer function of the feedback control system given as -

$$G(s) H(s) = \frac{K(s+3)}{s(s+2)} ; 0 < K < \infty$$

- (b) Consider a unity-feedback control system whose forward transfer function is -

$$G(s) = \frac{10K}{s(s+2)(s+8)}$$

Design a lag-lead compensator so that $K_v = 80 \text{ Sec}^{-1}$ and the dominant closed-loop poles are located at $-2 \pm j 2.3$

9. (a) Which are the various register internal to the microprocessor and can be used by users and which are the register not accessible to the user?
- (b) What is the difference between memory interfacing and device interfacing? Is it possible to interface memory in I/O mode?
- (c) The typical micro computer has a typewriter keyboard that allows to enter programs and data, a video screen displays answers and other information.

Suppose the video screen of a microcomputer displays the hexadecimal contents of the eight memory locations as :-

A7
28
C3
19
5A
4D
2C
F8

What are the binary contents of the memory locations?