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DEPARTMENT OF ELECTRCAL ENGINNERING
National Institute of Technology Calicut
END SEMESTER EXAMINATION, MAY 2014

ZZ 1003: Basic Electrical Sciences (Electrical)

Total Time for Electrical and Electronics: 3 hours.   Maximum: 25 Marks

Answer all questions

1. Find the sum of the 5 voltages given below and express it in rectangular and polar form. V_1=100 sin (ωt - $\pi/2$), V_2=50 cos (ωt + $\pi/2$), V_3=150 cos ωt, V_4=200 sin (ωt + $2\pi/3$) and V_5=100 cos (ωt - $\pi/6$). Represent the voltages in a phasor diagram.
                                                                (2.5 Marks)

2. In a series parallel circuit shown in Fig.1 below, the value of voltage across the parallel branches of circuit is 50V. Determine V in the circuit.
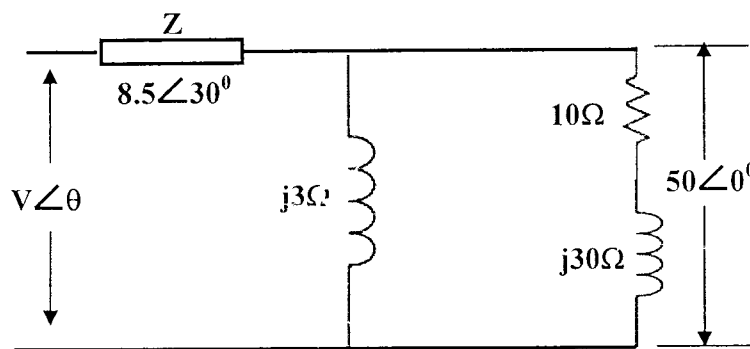   (3 marks)

Fig.1

3. A pure capacitor is to be inserted in a series circuit as shown in Fig 2, to make the power factor equal to 0.9. If the total current in the circuit is to lag the source voltage, what value of C should be used. Draw the power triangle.   (3 marks)
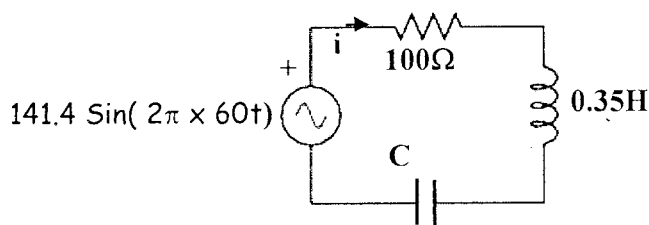

Fig. 2

Fig.3
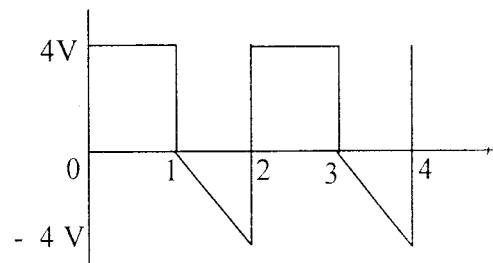
4. Find the form factor and peak factor of the voltage waveform given in Fig. 3.
                                                                (2.5 marks)

5. A flux of 0.05 Wb is linked with a coil of 200 turns when it carries a current of 15A. Calculate the inductance of this coil. If this current is uniformly reversed in 0.5 seconds, calculate the induced emf in the same coil. If a second coil of 500 turns is placed near to the first coil find the induced emf in the second coil. Take coefficient of coupling as 0.6.

    •   (2.5 marks)

6. A toroid is made of three parts of different materials of uniform cross sectional area Fig.4. Their mean length and relative permeability are l_1= 0.15m, $\mu r1$= 1447; l_2 = 0.30m, $\mu r2$= 5969; l_3= 0.45m, $\mu r3$= 47750. It is observed that a flux of 0.6 mWb is established when the current is 0.78A. Find the number of turns of the coil. (2.5 marks)
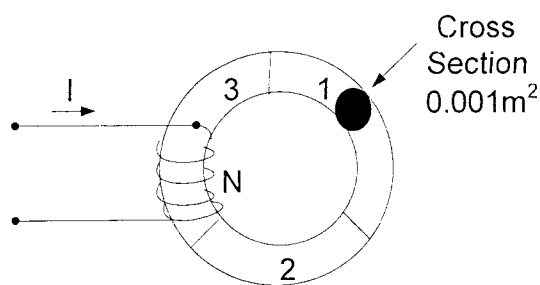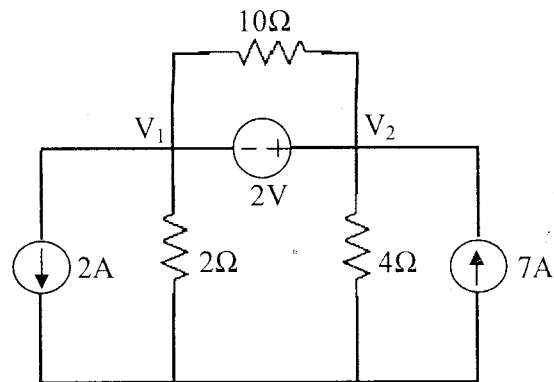

Fig. 4

Fig. 5

7. For the circuit given in Fig.5, find the voltages V1 and V2 using node voltage method.
(2.5 marks)

8. A sheet of mica, 1mm thick and of relative permeability 6, is interposed between two parallel brass plates 3mm apart. The remainder of the space between the plates is occupied by air. Calculate the area of each plate if the capacitance between them is 0.001µF. (2 Marks)

9. Find the equivalent resistance between terminals A and B of the circuit shown in fig.6.
(2 marks)

Fig. 6
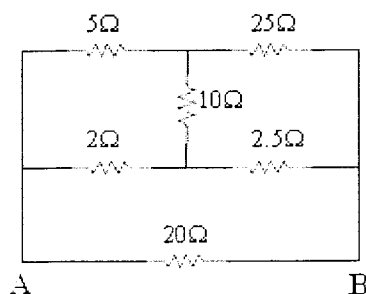

Fig.7
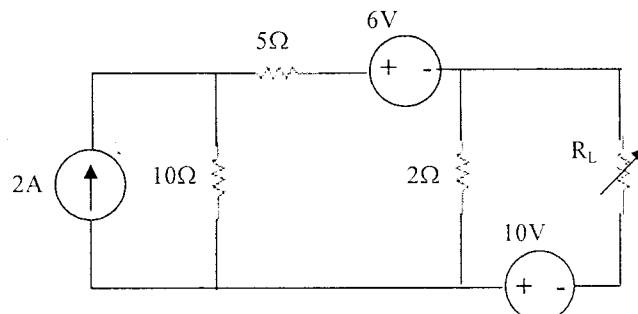
10. In the circuit shown in fig.7 what value of RL will absorb maximum power? Also find the maximum power. (2.5 Marks)

Time: 1.5 hours   **Answer All Questions**   Max. Marks: 25

1. The Zener diode in the circuit shown below regulates at 50V, over a range of diode currents from 5 to 40mA. The supply voltage V = 150V.   **[3]**

    a. Compute the value of R to allow voltage regulation from zero load current to maximum load current I_{Lmax}. What is I_{Lmax}?

    b. If R is set as found in part (a) and load current is fixed at 25 mA , what is the permissible range of supply voltage for the Zener diode to act as a regulator?
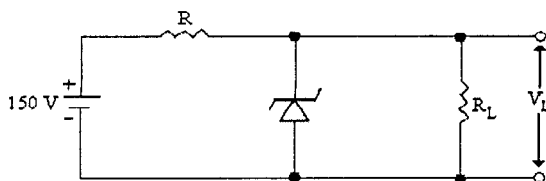
2. A transistor inverter is to be designed using a silicon transistor whose β may vary from 60 to 120. If the series base resistance is to be 100 kΩ, what should be the value of R_C? Assume that $V_{CC} = V_{HI} = 4.5V$.   **[2]**

3. In the amplifier circuit shown in the figure below, the values of R_B and R_C are such that the transistor is operating at $V_{CE}=3V$ and $I_c=1.5$ mA, when its β=150. For a transistor with β of 200, find the operating point (V_{CE}, I_c).   **[2]**
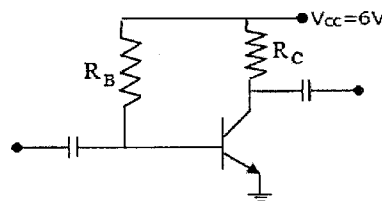
4. Perform subtraction using the r's complement for the following numbers   **[2]**

    a. $(101000)_2-(10101)_2$

    b. $(9250)_{10}-(98572)_{10}$

5. Simplify the following functions, and implement them with NOR gates.   **[3]**

    $$F = wx' + y'z' + w'yz'$$

6.a) Simpl $F(x, y, z) = [(x + y)(x + z)]'$ implement with NAND gates.   **[2]**

b) $F(A, B, C, D) = \Pi (0, 1, 2, 3, 6, 10, 11, 14)$

7. Design a logic circuit that will produce a 1, only when the number of 1's in a set of three inputs variables, A, B, and C are even. [2]

8. Design a logic circuit for 2-bit binary numbers $A=A_1A_0$ and $B=B_1B_0$. The outputs are F, G, and H, where F is 1 if A>B, G is 1 if A=B, and H is 1 if A<B. [3]

9. Find a simplified circuit for the logic circuit shown below that creates the same output.

[2]
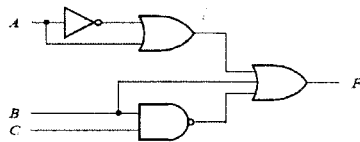
10. Draw the functional block diagram of a CRO and explain its operation. [2]

11. Simplify the given Boolean function using algebraic manipulation(not using K-Map) and implement using logic gates

$$Y = (A + B)(A'(B' + C'))' + A'(B + C)$$

[2]