Instructions for Candidates:

Attempt any Five questions in all.

Question No. 1 is compulsory.

Use of non-programmable scientific calculator is permitted.

1. (a) Determine the power delivered by the voltage source $V$ in terms of ‘$a$’ in Fig. 1. Also determine the power delivered when:

   (i) $a = 0$
   
   (ii) $a = 1$.

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Fig. 1
(b) Calculate the voltage $V_{ab}$ and $V_{xy}$ in the circuit shown below in Fig. 2.

![Fig. 2](image-url)

(c) In Fig. 3, switch is closed at $t = 0$ sec.

(i) Determine the power delivered to the load resistance. What current an ammeter will show if it is connected in series with the load resistor?

(ii) Suddenly the ammeter value drops to 0 amperes. Explain the reason. (Current rating of the load resistor is 0.5 ampere).

![Fig. 3](image-url)
(d) Draw its equivalent:

(i) Star Equivalent for Fig. 4(a).

(ii) Delta Equivalent for Figure 4(b).

\[ \text{Fig. 4(a)} \quad \text{Fig. 4(b)} \]

(e) Draw the dual of the circuit shown below in Fig. 5.

\[ \text{Fig. 5} \]
2.  

(a) Determine the current in all the three branches and verify the Tellegen's theorem for the circuit shown below Fig. 6.

(b) Determine the voltage across and the current through load using Millman's Theorem for the circuit shown below Fig. 7.
(5')

(c) Determine the current in all the branches using Mesh analysis shown below in Fig. 8.

\[ 5 + 5 + 5 = 15 \]

Fig. 8

3. (a) Draw the Thevenin’s equivalent of the circuit shown below in Fig. 9 and also calculate the current through load resistance.

Fig. 9
(b) What will be the maximum power delivered to the load in the circuit shown below in Fig. 10?

(c) Calculate the value of new currents of circuit shown below in Fig. 11 using the compensation theorem when the load resistance $R_L$ is increased by 25%. Also verify the compensation theorem.

Fig. 10

Fig. 11
4. (a) What is real and reactive power? Why the transformer rating is in VA (volt ampere) and not in watts?

(b) In a series RLC combination with \( R = 2 \) ohms, \( L = 1.6 \) milliHenry, \( C = 20 \mu F \) passes current of \( i = 3 \sin(5000t - 60^\circ) \) amp. Find the voltage across each element and the total voltage. Does voltage lead or lag current?

(c) Draw and calculate the average value of the full wave rectified signal.

(d) Calculate the rms value of the periodic signal shown in Fig. 12.

5. (a) In the circuit shown in Fig. 13, the switch is moved from position 1 to position 2 at \( t = 0 \). Calculate the voltage across both the capacitor \( V_{20\mu F}(t) \) and \( V_{6\mu F}(t) \).
and voltage across the resistor of 20 KΩ i.e. \( V_{20\,\text{KΩ}}(t) \). Also plot the voltage of capacitors as a function of time.

![电路图](image)

**Fig. 13**

(b) Find \( Z \) parameters of two port network shown below in Fig. 14.

![电路图](image)

**Fig. 14**

(c) For the RL circuit shown below in Fig. 15, find the current \( i_L \) for the following times:

(i) \( t = -1 \) ms
(ii) \( t = 0^+ \)

(iii) \( t = 0.3 \text{ ms} \)

(iv) \( t = \infty \)

\[ \text{Fig. 15} \]

\[ \text{Fig. 16} \]

\( \delta \) (a) Calculate the voltage \( V_{ab} \) using the Superposition Theorem and also make its Norton equivalent of circuit shown below in Fig. 16. Also plot the impedance diagram.
(b) Verify the reciprocity theorem for the circuit shown below in Fig. 17.

![Circuit Diagram](image17)

Fig. 17

7. (a) Calculate the $z$ and $h$ parameters of the network shown below in Fig. 18.

![Circuit Diagram](image18)

Fig. 18
(b) State and prove maximum power theorem for Impedance networks.

(c) What is the reciprocity condition for the \( h \)-parameter and ABCD parameters?

(d) Design a passive high pass RC filter with roll of rate 20 db/decade and cut-off frequency 5 kHz. Also plot the frequency response of ideal and practical filter of same type. How many capacitors and inductors are needed to design a low pass filter with roll of rate 80 db/decade? 

\[ 4 + 5 + 1 + 5 = 15 \]