(ix) Two 'two-port' networks are connected in parallel. The combination can be represented as a single two -port network by
(a) multiplying individual-parameter matrices
(b) dividing individual-parameter matrices
(c) adding individual-parameter matrices
(d) subtracting individual-parameter matrices.

(x) The transfer function $\frac{V_2(s)}{V_1(s)} = \frac{10s}{s^2+10s+100}$ is for an
(a) active low pass filter (b) active high pass filter
(c) active band pass filter (d) active band stop filter.

Group – B

2. (a) Determine node voltages of the circuit of Fig 2(a). Also determine i_x.

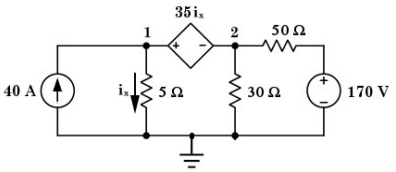

Fig. 2(a)

(b) Calculate the current through the 6 Ω resistor of the circuit of Fig. 2(b) using superposition theorem.

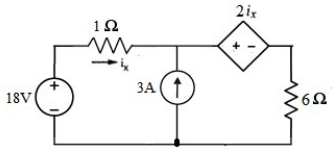

Fig. 2(b)

6 + 6= 12

3. (a) In the circuit of Fig. 3(a), find Thevenin's equivalent circuit looking from the terminals A-B.

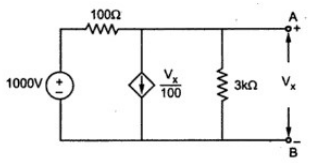

Fig. 3(a)

(b) Use Norton's theorem to find the current through 1.6Ω for the circuit shown in Fig. 3(b).

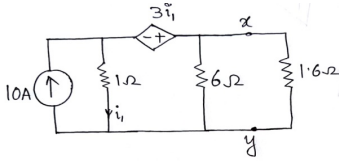

Fig. 3(b)

6 + 6= 12

Group – C

4. (a) Define unit impulse function. Find its Laplace transform.

(b) Find Laplace transform of the waveform shown in Fig. (4).

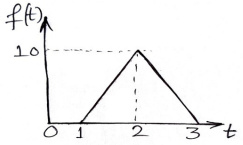

Fig. (4)

(c) Find f(t) where f(t) is the Laplace inverse of $F(s) = \frac{1}{1+e^{-sT}}$. Sketch the waveform of f(t).

(2+2) + 4 + (3 + 1)= 12

5.(a) In Fig. 5(a), the initial voltage across the capacitor is 1V. Find the expression of v(t).

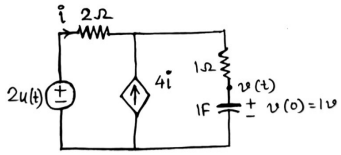

Fig. 5(a)

(b) In the circuit of Fig. 5(b) the switch K is closed at t=0. Determine the current i(t) for t>0. Assume zero initial conditions.

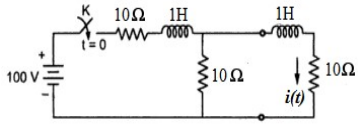

Fig. 5(b)

6 + 6 =12

Group – D

6.(a) A reduced incidence matrix of a graph is given by

$$A = \begin{bmatrix} -1 & 1 & 0 & -1 & 0 & 0 \\ 0 & -1 & 1 & 0 & 1 & 0 \\ 1 & 0 & -1 & 0 & 0 & 1 \end{bmatrix}$$

Draw the directed graph corresponding to this matrix.

(b) For the network shown in Fig. 6, draw the directed graph, give fundamental cutset matrix and hence find equilibrium equations on voltage basis. Select the circuit elements (2), (3) and (4) as the twigs in the tree. The element numbers are given along with the directions of the currents through the elements.

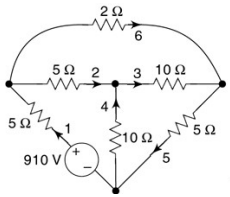

Fig. 6

3 + (1+ 2 + 6) =12

7.(a) Define transmission parameters. Derive the relationship between hybrid parameters and transmission parameters.

(b) State Reciprocity theorem. For transmission parameters, derive the condition of reciprocity.

(c) Determine Transmission parameters of the circuit shown in Fig. (7).

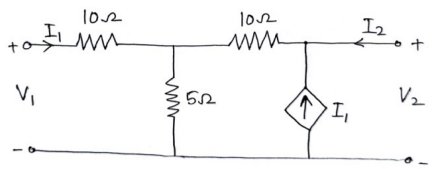

Fig. (7)

(1 + 2) + (1 + 2) + 6 =12

Group – E

8.(a) Briefly discuss the operating principle of a second order active high pass filter and derive its gain–frequency characteristics. Explain the design procedure of a second order active high pass filter.

(b) A band – pass filter has a resonating frequency of 950 kHz and a bandwidth of 2700 Hz. Find its lower and upper cut- off frequencies.

(2+ 5 + 2) + 3=12

9.(a) Explain '.DC', '.AC' and '.PRINT' statements in SPICE with examples.

(b) A series R-C circuit with C=0.1μF is excited by a voltage source v(t). Write a SPICE program to plot the current response, voltage across resistor and voltage across capacitor for R=100Ω, 200Ω and 500Ω respectively. The waveform of v(t) is shown in Fig. (9).

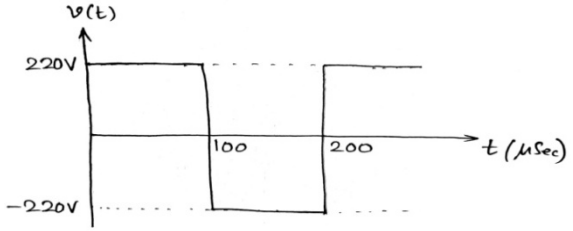

Fig. (9)

6 + 6 =12

B.TECH/EE/3RD SEM/ELEC 2102/2018
CIRCUIT THEORY
(ELEC 2102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The coefficient of coupling for two coils having L_1= 0.9H, L_2 =0.4 H and M = 0.25H is :
(a)0.916 (b) 0.416 (c) 0.614 (d) 0.461.

(ii) The initial value of g(t) whose Laplace transform $G(s) = \frac{2s^2+s+6}{s(s^2+s+4)}$ is
(a) 2 (b) ∞ (c) 0 (d) 1.

(iii) An RL circuit has R = 2 Ω and L = 0.5H. The time needed for the inductor current to reach 95% of its steady value is:
(a)0.5s (b) 1s (c) 2s (d) 0.75s.

(iv) Voltage in an RLC parallel circuit when excited by a constant current source is oscillatory when
(a)$R = 2\sqrt{\frac{L}{C}}$ (b) $R = \infty$ (c) $R < 2\sqrt{\frac{L}{C}}$ (d) $R = 0$.

(v) The dc gain of a system having transfer function $H(s) = \frac{12s^2}{(s+3)(s+4)}$ is
(a) 12 (b) 1 (c) 2 (d) 0.

(vi) The '. TRAN' statement in SPICE is used to analyze the network in
(a) frequency domain (b) time domain
(c) both frequency and time domain (d) Laplace domain.

(vii) Double integration of a unit step function would lead to
(a) an impulse (b) a parabola (c) a ramp (d) zero.

(viii) The graph of a network has six branches with three tree branches. The minimum number of equations required for the solution of the network is
(a) 2 (b) 3 (c) 4 (d) 5.