*Total number of printed pages:* **4** **UG/3rd Semester/UECE304**

**2022**

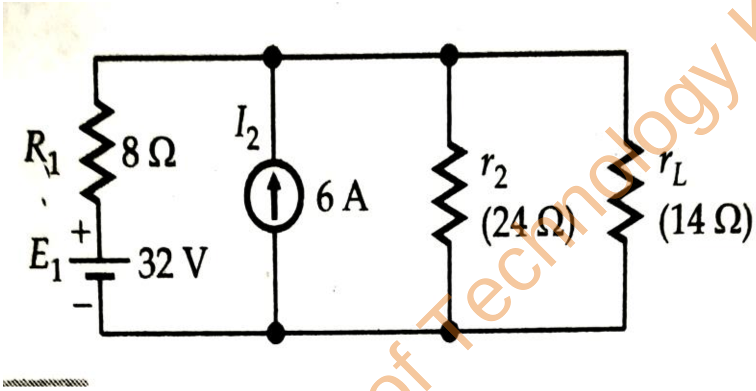
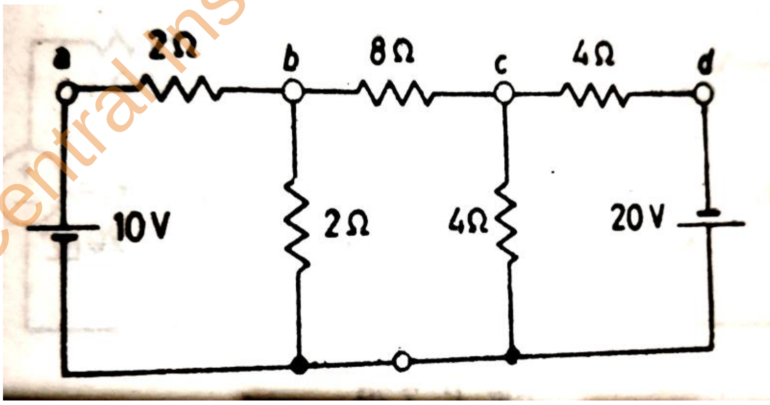
**NETWORK THEORY**

*Full Marks : 100*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

*Answer* ***any five*** *questions.*

| | | | |
|---|---|---|---|
| 1. | a) | What is meant by short and open circuits? Differentiate a network and circuit. In the circuit shown in figure 1(a), find the current through $r_L$.<br><br><br>Figure 1(a) | 3+4+6=13 |
| | b) | Determine the current passing through the different branches of the circuit in figure 1(b), by the principle of superposition.<br><br><br>Figure 1(b) | 7 |
| 2 | a) | Define linear and non-linear network. What are the applications of Maximum power transfer theorem? | 4+3=7 |
| | b) | State and prove superposition theorem. Draw the Thevenin's equivalent of | 6+7=13 |

<table>
<tr><td></td><td></td><td>the circuit shown in figure 2(b) and find the load current.

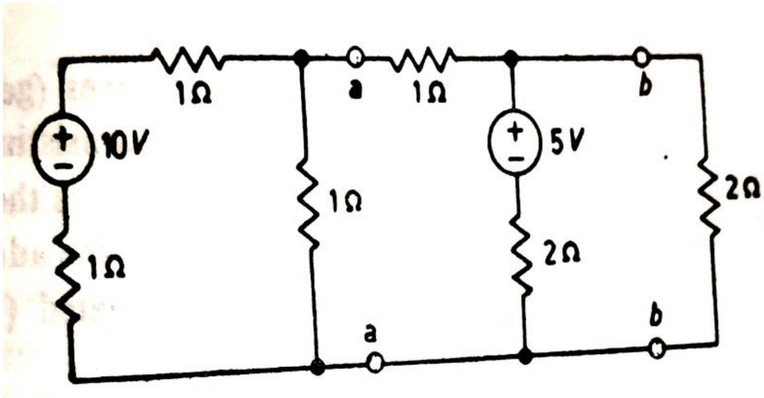



Figure 2(b)</td><td></td></tr>
<tr><td>3</td><td>a)</td><td>Express the Fourier series coefficients (i) for trigonometric function, (ii) for complex exponential. Find the Fourier series coefficients of the waveform shown in figure 3(a).

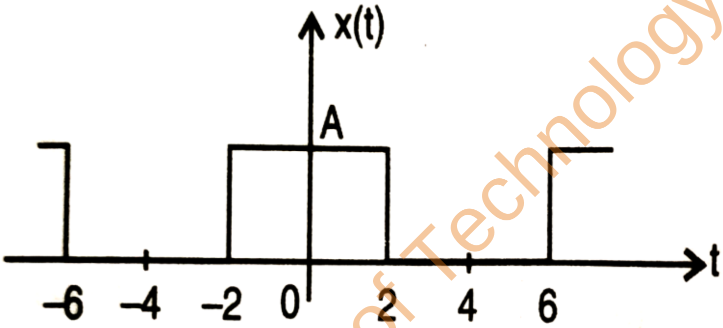



Figure 3(a)</td><td>5+5=10</td></tr>
<tr><td></td><td>b)</td><td>Define Fourier transform of a continuous- time function. Find the Fourier series representation of waveform given in figure 3(b) (using trigonometric Fourier series). 4+6=10

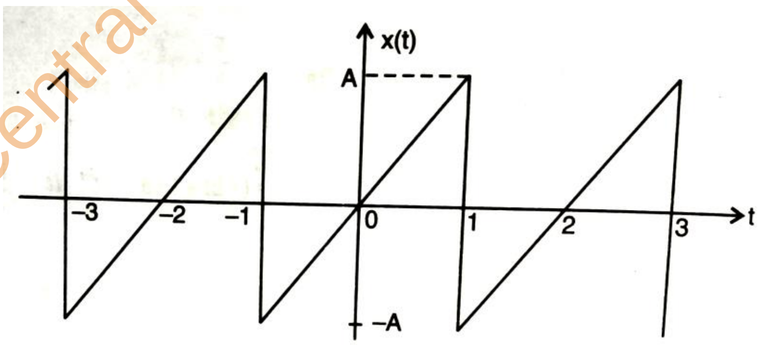
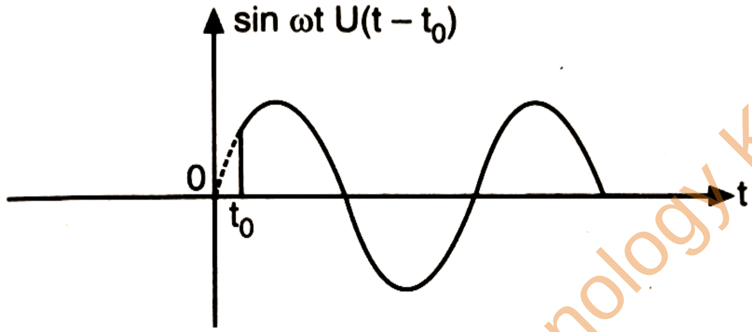
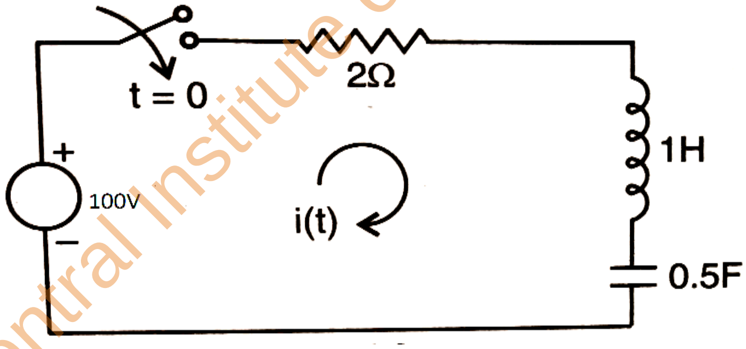
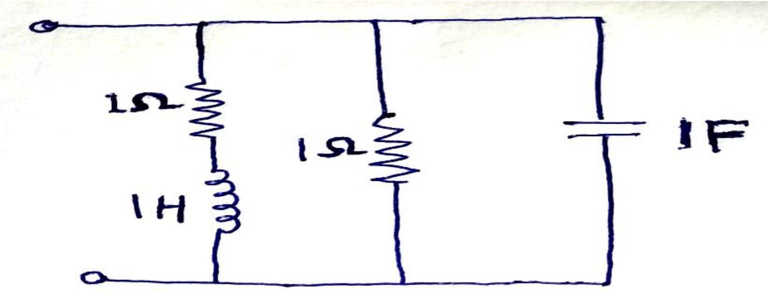
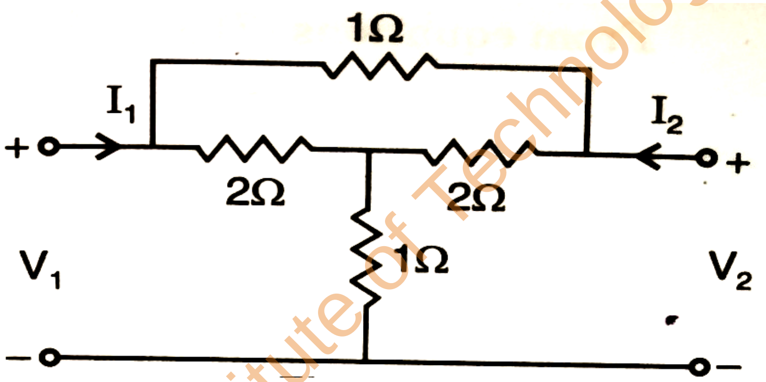
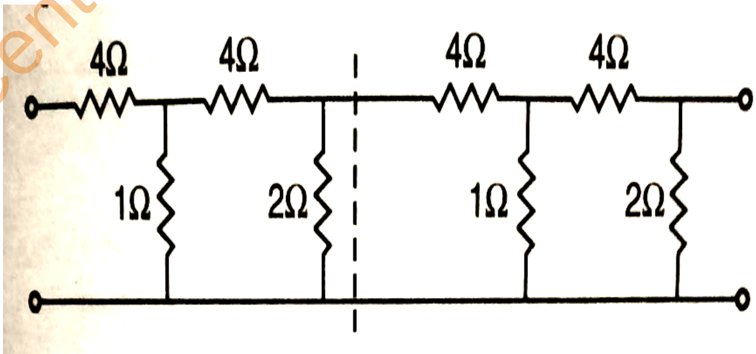



Figure 3(b)</td><td>4+6=10</td></tr>
<tr><td>4.</td><td>a)</td><td>Use Laplace transform method to solve the differential equation</td><td>6</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | $\frac{d^2v}{dt^2} + \frac{3dv}{dt} + 2v = 4\,U(t)$  [Given $v(0^-) = 0$ and $\frac{dv}{dt}(0^-) = 5$] | |
| | b) | Define Laplace transform and inverse Laplace transform. Find the inverse Laplace transform of the following function<br>(i) $\mathbf{F(s)} = \frac{s+5}{s(s^2+2s+5)}$ (ii) $\mathbf{I(s)} = \frac{1}{s(s+1)^2(s+2)}$ | 5+4+5=14 |
| 5 | a) | Find the Laplace transforms of the following functions.<br>(i) $e^{-at}U(t)$ (ii) $e^{-at}U(t-b)$ (iii) $e^{-a(t-b)}U(t-b)$<br>(iv) Laplace transform of the following sinusoidal function.<br> | 2+3+3+5<br>=13 |
| | b) | In the series R-L-C circuit shown in figure 5(b), there is no initial charge on the capacitor. If the switch S is closed at t=0, determine the resulting current.<br><br>Figure 5(b) | 7 |
| 6 | a) | What is the concept of complex frequency? Check whether given functions are suitable in representing the transfer functions or not?<br>(i) $\mathbf{G_{21}(s)} = \frac{5s+2}{5s^3+4s^2+1}$ (ii) $\mathbf{G_{21}(s)} = \frac{2s^2+5}{3s^2+9s+1}$ (iii) $\boldsymbol{\alpha_{21}(s)} = \frac{2s^2+5s+1}{s+7}$<br>(iv) $\frac{1}{s^2+2s}$ | 4+1.5×4=<br>10 |
| | b) | Explain the concept of poles and zeros in a network function. Find the driving point impedance of the network shown in figure 6(b). Find the | 3+3+4=10 |

| | | | |
|---|---|---|---|
| | | poles and zeros of the network and locate them in the s-plane.<br><br><br>Figure 6(b) | |
| 7 | a) | Define all the characteristics of filter networks. Prove that the characteristics impedance of symmetrical T- network $Z_{OT} = \sqrt{Z_{OC} Z_{SC}}$, where $Z_{OC}$ is open circuit impedance and $Z_{SC}$ is short-circuit impedance. | 4+5=9 |
| | b) | Find the short circuit and open circuit impedances of the network shown in figure 7(b).<br><br><br>Figure 7(b) | 6 |
| | c) | Determine the ABCD parameters of the two networks connected in cascade as shown in figure 7(c).<br><br><br>Figure 7(c) | 5 |