ROLL NO. ___________________

Code: DE57 **Subject: NETWORKS AND TRANSMISSION LINES**

DipIETE – ET (NEW SCHEME)

Time: 3 Hours **JUNE 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. Which of the following is an ideal voltage source?

(A) Voltage independent of current **(B)** Current independent of voltage
(C) Both **(A)** and **(B)** **(D)** None of the above

b. The voltage due to self inductance and mutual inductance in the coil as shown in Fig. 1.

(A) $V_1 = L_1 \frac{di_1}{dt} - \frac{Mdi_2}{dt}$

(B) $V_1 = L_2 \frac{di_1}{dt} + \frac{M_1 di_2}{dt}$

(C) $V_1 = L_1 \frac{di_1}{dt} + \frac{Mdi_2}{dt}$

(D) $V_1 = L_2 \frac{di_1}{dt} + \frac{Mdi}{dt}$

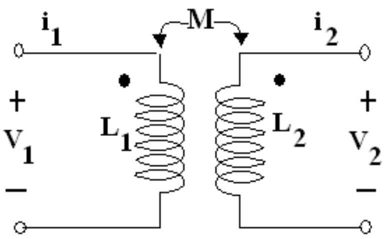


Fig. 1

c. The Laplace transform F(s) of a time function f(t) is defined as

(A) $\mathcal{L}[f(t)] = F(s) = \int_0^{\infty} f(t).e^{-st}dt$ **(B)** $F(s) = \int_{\infty}^{0} f(t).e^{-st}dt$

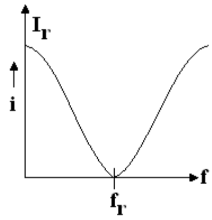
(C) $F(s) = \int_{-\infty}^{\infty} f(t).e^{-st}dt$ **(D)** $F(s) = \int_0^{1} f(t).e^{-st}dt$

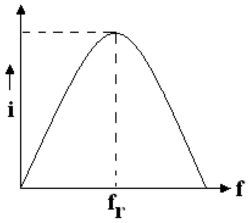
d. The laplace transform of $\sin \omega_0 t$ is

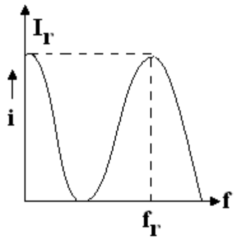
(A) $\frac{s^2}{\omega_0^2 + s^2}$ **(B)** $\frac{s}{\omega_0^2 + s^2}$

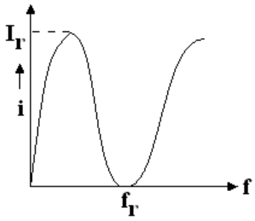
(C) $\frac{\omega_0}{s^2 + \omega_0^2}$ **(D)** $\frac{1}{s^2 + \omega_0^2}$

e. The current response of a series resonant RLC circuit is

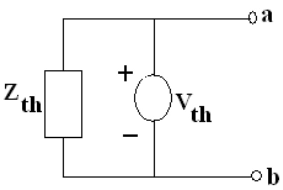
(A) 

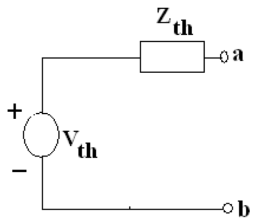
(B) 

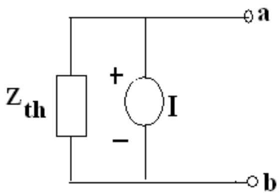
(C) 

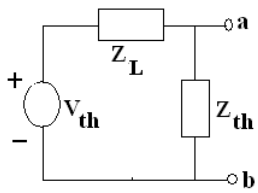
(D) 

f. Thevenin's equivalent circuit of a linear active network is

(A) 

(B) 

(C) 

(D) 

g. The characteristics impedance of a T network is

(A) $Z_{OT} = \sqrt{\dfrac{Z_1}{Z_1 + 4Z_2}}$

(B) $Z_{OT} = \sqrt{\dfrac{Z_2}{\dfrac{Z_1}{4} + Z_2}}$

(C) $Z_{OT} = \sqrt{Z_1 Z_2 \left(1 + \dfrac{Z_1}{4Z_2}\right)}$

(D) $Z_{OT} = \sqrt{\left(1 + \dfrac{Z_1}{4Z_2}\right) Z_2}$

h. The reflection coefficient K is

(A) $|K| = \dfrac{|V_{max}| - |V_{min}|}{|V_{max}| + |V_{min}|}$

(B) $|K| = \dfrac{|V_{max}| + |V_{min}|}{|V_{max}| - |V_{min}|}$

(C) $|K| = \dfrac{|V_{max}|}{|V_{min}|}$

(D) $|K| = \dfrac{|V_{min}|}{|V_{max}|}$

i. SWR (Standing Wave Ratio) is

(A) $S = 1 + |K|$ **(B)** $S = 1 - |K|$

(C) $S = \frac{1+|K|}{1-|K|}$ **(D)** $S = \frac{1-|K|}{1+|K|}$

j. Smith chart can be used to

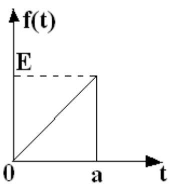
(A) plot an impedance **(B)** determine VSWR (Voltage Standing Wave Ratio)
(C) None of the above **(D)** Both **(A)** and **(B)**

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

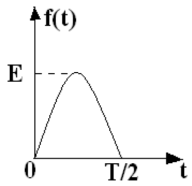
Q.2 a. Find the laplace transform of the following functions:
(i) $f(t)=t^2$ (ii) ramp function $\{f(t) = t\}$
(iii) $f(t)=\sin \omega t$ (iv) $f(t) = t^n$ **(4×2)**

b. Find the laplace transform of given functions:

(i) f(t)



(ii) half cycle of sine wave



(4×2)

Q.3 a. Verify the reciprocity theorem for the network as shown in Fig. 2 **(8)**

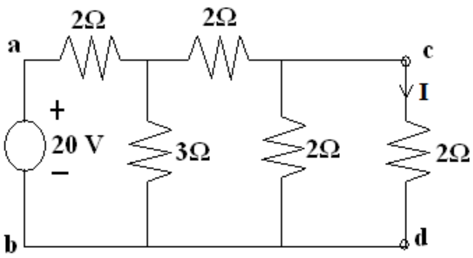


Fig. 2

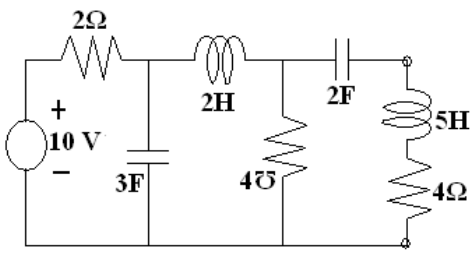


Fig. 3

b. Draw the dual for the given network in Fig. 3. **(8)**
(Mark nodes in each of the loop and a reference node outside circuit)

Q.4 a. Draw the expressions for resonant frequency, selectivity, bandwidth and Q factor for a series resonant RLC circuit. **(4×2)**

b. An induction of 0.5H, a resistance of 5Ω and a capacitance of 8μF are in series across a 220 V ac supply. Calculate the frequency at which the circuit resonates. Find the current at resonance, bandwidth half power frequencies and the voltage across the capacitance at resonance. **(4×2)**

Q.5 a. Draw the relation between
(i) y and z parameter
(ii) Transmission line parameters and z parameters. **(4+4)**

b. Two identical sections of T networks are connected in cascade. Obtain the circuit parameters of the resulting circuit (Fig. 4). **(4+4)**

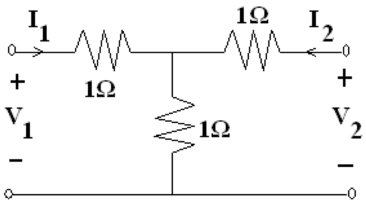


Fig. 4

Q.6 a. Derive the expression for Z_o and γ of a line composed of cascaded T sections. **(8)**

b. The primary line constants of a transmission line/km:R=6Ω, L=2.2 mH, C=0.005μF, G=0.25μ℧, f=800 Hz. Calculate
(i) attenuation suffered by the signal after travelling a distance of 50 km at the given frequency
(ii) velocity by which the signal travels through the line. **(8)**

Q.7 a. A 50 MHz open wire line is to be built of copper wire $[\varepsilon_r = 1]$ of diameter 3.264 mm, R_o=425 Ω. Find
(i) the desired spacing 'd'
(ii) calculate the total L & C of 5 m of this line if the line is dissipationless. **(8)**

b. Explain how a transmission line can be used as
(i) impedance transformer (ii) impedance inverter
(iii) coupling to an antenna (iv) input impedance of this line. **(4×2)**

Q.8 a. What is inductance? Derive relation for energy stored in inductor. **(8)**

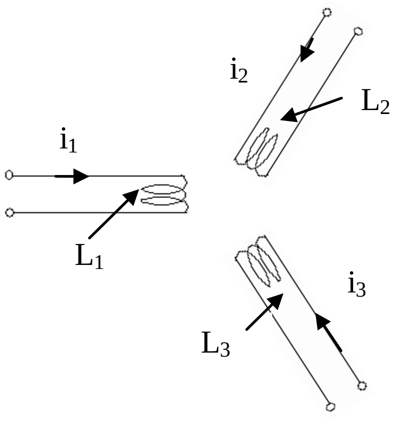


Fig.5

b. Find emf equation for three mutually coupled inductors as Fig. 5. **(8)**

Q.9 a. Derive the expressions for the for the elements of m-derived
(i) T filter (ii) π-filter. **(4+4)**

b. Design a prototype band pass filter with cut-off frequencies 1.5 kHz and 5 kHz design impedance of 500Ω. **(8)**