ROLL NO. _____

Code: AE59/AE110 **Subject: CIRCUIT THEORY & DESIGN**

AMIETE – ET (Current & New Scheme)

Time: 3 Hours **DECEMBER 2018** **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. Kirchhoff's current law states that
(A) net current flow at the junction is positive
(B) algebraic sum of the currents meeting at the junction is zero
(C) no current can leave the junction without some current entering it.
(D) total sum of currents meeting at the junction is zero

b. Kirchhoff's current law is applicable to only
(A) junction in a network
(B) closed loops in a network
(C) any electrical circuits
(D) any electronic circuits

c. Thevenin resistance R_{th} is found
(A) by removing voltage sources along with their internal resistances
(B) by short-circuiting the given two terminals
(C) between any two 'open' terminals
(D) between same open terminals as for E_{th}

d. An ideal voltage source should have
(A) large value of e.m.f. **(B)** small value of e.m.f.
(C) zero source resistance **(D)** infinite source resistance

e. For maximum transfer of power, internal resistance of the source should be
(A) equal to the load resistance **(B)** less than the load resistance
(C) more than the load resistance **(D)** None of these

f. The circuit whose properties are same in either direction is known as
(A) unilateral circuit **(B)** bilateral circuit
(C) reversible circuit **(D)** irreversible circuit

g. The network function $Z(s) = \dfrac{(s+1)(s+4)(s+8)}{s(s+2)(s+6)}$ represents
(A) LC circuit **(B)** RL circuit
(C) RLC circuit **(D)** None of these

h. Which of the following is not a nonlinear element?
(A) Gas diode **(B)** Heater coil
(C) Tunnel diode **(D)** Electric arc

i. The superposition theorem is applicable to
(A) voltage only **(B)** current only
(C) both voltage and current **(D)** voltage, current and power

j. Two-port network is symmetrical if
(A) $z_{12}=z_{21}$ **(B)** $y_{12}=y_{21}$
(C) AD=1 **(D)** A=D

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

Q.2 a. Define graph and tree with example. Mention the properties of a tree. Illustrate topological structure of the following networks frequently used in electrical engineering like, ladder, bridge, bridged-T and lattice network. **(2+2+6)**

b. Explain source transformation for independent and dependent sources. Consider an RLC parallel network and mention the steps to be followed to obtain the dual of the network. **(6)**

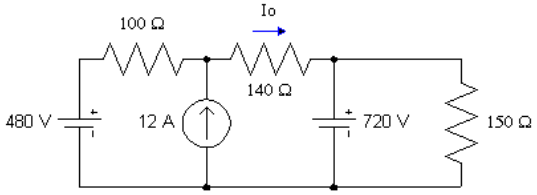
Q.3 a. What is a signal? Consider suitable signals to define time constant, dc value, rms value, duty cycle and crest factor. **(2+4)**

b. Consider an RLC series circuit. Describe the response for different location of roots in s-plane. Obtain critical resistance and natural frequency of the circuit. **(10)**

Q.4 a. State shifting theorem. Find the Laplace Transform (LT) of $\sin(wt)$ and t from basic definition of LT. Using shifting theorem find LT of $e^{-t}\mathrm{Sin}(wt)$. **(3+2+3)**

b. State Final value theorem for a function. When is this theorem not applicable? Find the solution of the differential equation using Laplace Transform: $\frac{d^2i}{dt^2}+4\frac{di}{dt}+5i=5u(t)$, given $i(0-)=1$ and $\frac{di}{dt}(0-)=2$ **(2+2+4)**

Q.5 a. State Superposition principle. Find I_0 for the following circuit using this principle. **(2+6)**

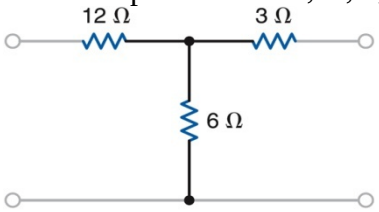


b. State reciprocity theorem and Thevenin's theorem with suitable examples. **(4+4)**

Q.6 a. What do you mean by a network function in a two-port network? What are driving point function and transfer function? Mention the properties of each of these functions. **(2+3+3)**

b. Test whether the polynomial $F(s) = s^4 + s^3 + 5s^2 + 3s + 4$ is Hurwitz or not and why, justify. Find the range of value of 'a', so that $P(s) = s^4 + s^3 + as^2 + 2s + 3$ is Hurwitz. **(4+4)**

Q.7 a. For the network calculate the parameters: Z, Y, h, T and g parameters. **(10)**



b. Obtain a one-generator equivalent circuit to the general two-port network in terms of the Z functions. Express transmission parameters (T) in terms of impedance parameters (Z). **(3+3)**

Q.8 a. Mention the properties of driving point L-C immitance and R-C driving point impedance functions. **(6)**

b. Realize the impedance function Z(s) and admittance function Y(s) using partial fraction expansion method where $Z(s) = \frac{2(s^2+1)(s^2+9)}{s(s^2+4)}$ and $Y(s) = \frac{s(s^2+2)(s^2+4)}{(s^2+1)(s^2+3)}$ **(10)**

Q.9 a. Differentiate minimum and non-minimum phase network. Give the concept of pole and zero and zeros of transmission. **(3+3)**

b. What is a filter? Mention stop band, pass band and cut-off frequency with reference to a low pass filter. Differentiate between Butterworth and Chebyshev approximations. What frequency transformation is required to convert a low pass filter to a high pass filter? **(2+3+3+2)**