ELECTRICAL ENGINEERING DEPARTMENT

ELL202 CIRCUIT THEORY

MAJOR **23/11/2016** **09:30-10:30** **MM:50**

Q1. Realize $Z(s) = \dfrac{36s^4 + 30s^3 + 24s^2 + 5s + 1}{18s^3 + 6s^2 + 3s}$ in two different ways. (8)

Q2. An LC network N, shown in Fig.1, has three zeros of transmission: one at $s = 0$ and two at $s = \infty$.

(a) Show that the transfer impedance $Z_{21}(s) = \dfrac{V_2(s)}{I_1(s)}$ is of the form $\dfrac{Ks}{s^3 + as^2 + bs + c}$.

(b) Given that open-circuit transfer parameter of network N is $z_{21}(s) = \dfrac{K s}{s^2 + 4}$, determine *a* and *c*, and also the condition on *b* such that $Z_{21}(s)$ is realizable.

(c) Choose a suitable value of *b* and realize N in two different ways. (9)

Q3. Synthesize the voltage transfer function $T(s) = \dfrac{V_2(s)}{V_g(s)} = \dfrac{0.5s}{s^3 + 2s^2 + 2s + 1}$ using bridged-T constant resistance networks. (7)

Q4. For a positive-real function $Z(s)$, $\mathrm{Re}\{Z(j\omega)\} = \dfrac{\omega^4 + 21\omega^2}{\omega^4 + 17\omega^2 + 16}$.

(a) Find minimum value of $\mathrm{Re}\{Z(j\omega)\}$ and the frequency at which the minimum occurs.

(b) Determine a realizable $Z(s)$ for the given $\mathrm{Re}\{Z(j\omega)\}$.

(c) Synthesize $Z(s)$. (9)

Q5. Given $Z(s) = \dfrac{2(s+1)(s+3)}{(s+2)(s+6)}$ *with* $s = \sigma + j\omega$, find and draw a plot for $Z(\sigma)$ *Vs.* σ *for* $\sigma \le 0$. Clearly mark all points in the plot. Realize $Z(s)$ in Foster-II form. (9)

Q6. Determine if the following polynomials are Hurwitz.

$$s^7 + 6s^6 + 14s^5 + 18s^4 + 17s^3 + 12s^2 + 4s$$

$$s^6 + 7s^4 + 14s^2 + 8$$

Also, find all imaginary roots of these polynomials. (8)

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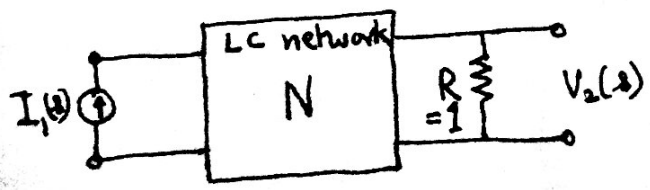

Fig.1