Name of the Program: B. Sc. Engg. (EE)
Semester: 2nd Semester

Date: May 28, 2024
Time: 10:00 am – 1:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4201
Course Title: Electrical Circuit II

Summer Semester, A.Y. 2022 – 2023
Time: 3 Hours
Full Marks: 150

There are **2 (two)** questions. Answer all **2 (two)** questions. The symbols have their usual meanings. Marks of each question and corresponding COs and POs have been written in the brackets on the right margin. Programmable calculators are not allowed. Do not write on this question paper. Assume suitable values for any **missing data**.

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1. a) Determine the $\pi - equivalent$ conductively coupled circuit for the linear transformer depicted in Fig. 1. (05) (CO1) (PO1)

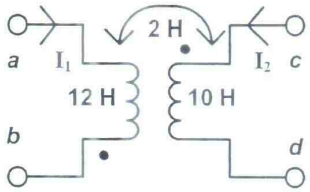

Fig. 1

b) Construct the dual of the circuit of Fig. 7 of question 2(h). (05) (CO1) (PO1)

c) For the two-port network shown in Fig. 2, construct the equivalent two-port network with the admittance parameters. (10) (CO1) (PO1)

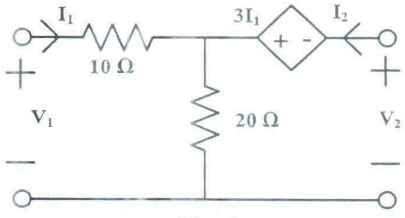

Fig. 2

2. a) The switch for the circuit in Fig. 3 is closed at $t = 0$. Find $i(t)$ and $v(t)$ for all time. (15) (CO2) (PO2)

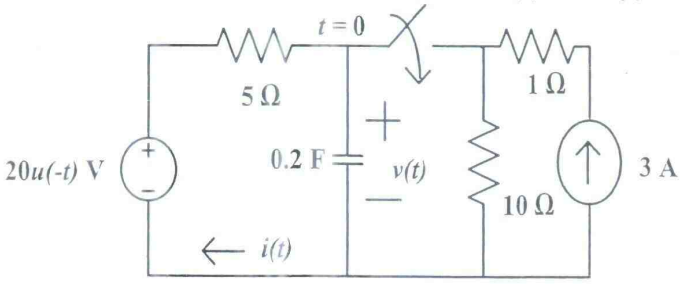

Fig. 3

b) Determine the coupling coefficients, k_1 and k_2 for the circuit depicted in Fig. 4. Calculate the energy stored in the coupled inductors at time $t = 1\ s$ if $\omega = 4\ rad/s$. (15) (CO1) (PO1)

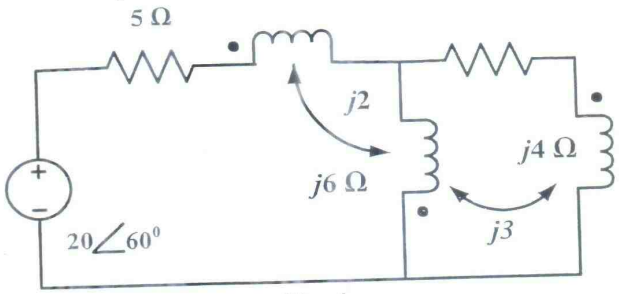

Fig. 4

c) Analyze the quality factor and bandwidth of a parallel resonant RLC circuit. Evaluate their codependence in terms of the following narratives: (15) (CO2) (PO2)

i) Necessary response curves,
ii) Resonant frequency (ω_0), lower cut-off frequency (ω_1), and upper cut-off frequency (ω_2),
iii) Necessary expressions for bandwidth (B) and quality factor (Q), and
iv) Symmetry of the response curves.

d) Determine the type of the filter depicted in the circuit of Fig. 5. Calculate the transfer function $V_0(\omega)/V_S(\omega)$, cut-off frequency/frequencies, poles, and zeros for the filter response. (15) (CO2) (PO2)

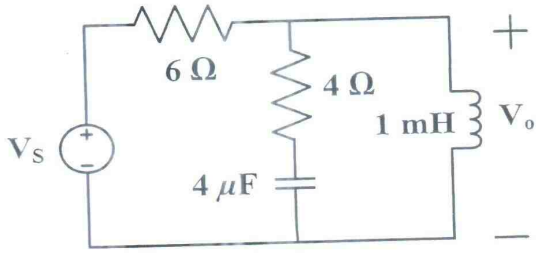

Fig. 5

e) Design a bandpass filter with a lower cutoff frequency of 20.1 kHz and an upper cutoff frequency of 20.3 kHz assuming the resistance of the filter, $R = 20\ k\Omega$. Calculate L, C, Quality factor, Q, and Bandwidth, B for this filter. Find out its transfer function and plot its magnitude response. (15) (CO2) (PO2)

f) For the circuit in Fig. 6, find $v(t)$ for all t and sketch the waveshape for $v(t)$. (15) (CO2) (PO2)

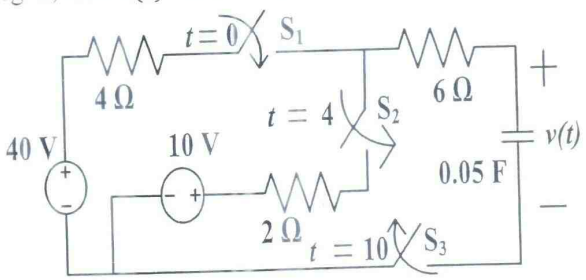

Fig. 6

g) Analyze the source-free response and step response of an RC circuit and the source-free response and step response of a parallel RLC circuit. Sketch the response curves of $v(t)$ and $i(t)$ for each circuit considering different states of V_S and V_0. Differentiate between the natural, forced, transient, and steady-state responses of $v(t)$ and $i(t)$ with expressions for appropriate response curves. (20) (CO2) (PO2)

h) For the circuit shown in Fig. 7, calculate: $i(0^+)$, $v(0^+)$, $v_R(0^+)$, $i(\infty)$, $v(\infty)$, $v_R(\infty)$, $\frac{di(0^+)}{dt}$, $\frac{dv(0^+)}{dt}$ and $\frac{dv_R(0^+)}{dt}$. (20) (CO2) (PO2)

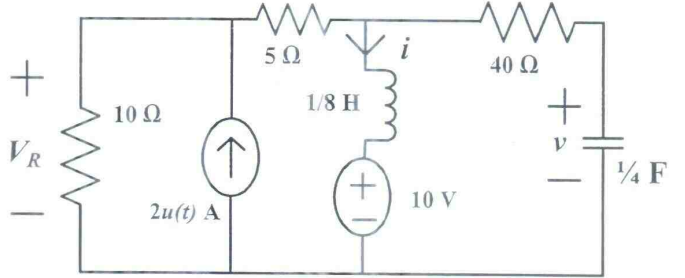

Fig. 7