BITS, PILANI – DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY

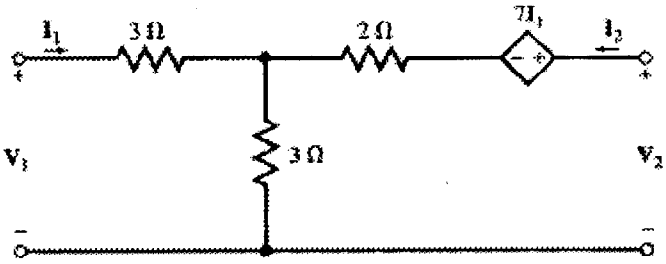
YEAR II EEE C272 / INSTR C272 – CIRCUITS AND SIGNALS

Comprehensive Exam **Date: 1 June 2009**
Max marks: 80 **Weightage: 40%** **Time allowed: 3 hours**

Note: Answer ALL questions. This paper consists of three sections: Answer Section A in the Blue coloured booklet, Section B in the green coloured booklet and Section C in the red coloured booklet.

SECTION A (Answer this section in BLUE booklet)

1. (a) Find the z- parameters of the following circuit



(8 marks)

(b) Draw the equivalent circuit for the above in terms of the z-parameters

(2 marks)

2. (a) Determine the whether the signal $f(t) = \cos t + \sin(\sqrt{2}.t)$ is periodic or not. If so find its fundamental period.

(5 marks)

(b) Given $x(t) = Ae^{-\alpha t}u(t)$ where $\alpha > -0$. State whether *x(t)* is energy signal or power signal. Explain.

(3 marks)

3. A signal *x(t)* is represented by $x(t) = \cos^2(\frac{\pi t}{2})$. What are its even and odd components?

(4 marks)

SECTION B (Answer this section in GREEN booklet)

4. Obtain the Fourier series for a periodic train of pulses of period *T*. Each pulse has a width δ and height *A*. Sketch its Fourier spectrum. Also illustrate the effect on the spectrum when the period is doubled. What happens to the spectrum when $T \to \infty$?

(10 marks)

5. (a) Find and sketch the Fourier transform of

$$x(t) = \begin{cases} e^{j2\pi t}, & |t| < 1 \\ 0, & otherwise \end{cases}$$

(4 marks)

(b) Sketch the periodic function $f(t)$ that is made up of unit impulses having period T. Find and sketch its Fourier transform $F(\omega)$. What interesting relationship do you observe between $f(t)$ and $F(\omega)$?

(6 marks)

6. (a) Find the Fourier transform of $\cos^2 2\pi f_o t$ from the frequency convolution theorem. Check your answer by expanding $\cos^2 2\pi f_o t$ using trigonometric identities.

(6 marks)

(b) Obtain the Fourier transform of a signal $x(t)$ multiplied by a sinusoid $\cos \omega_o t$. What property does this result indicate?

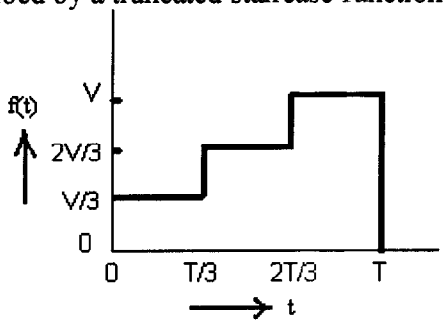
(4 marks)

SECTION C (Answer this section in RED booklet)

7. (a) State and prove the time shifting property of Laplace transform.

(4 marks)

(b) A signal f(t) is described by a truncated staircase function shown in Figure below:



Assume f(t) to be zero outside of the range indicated in the figure. Express f(t) in terms of unit step functions. Apply the time shifting property to determine the Laplace transform of f(t).

(6 marks)

8. (a) Derive, from first principles, the z-transform of u[n].

(4 marks)

(b) A system has an impulse response given by h[n] = u[n]. Determine the input to the system if the output is given by y[n] = δ[n-2].

(6 marks)

9. Using suitable butterfly diagrams, explain how a 4-point DFT can be realized using two 2-point DFTs. Illustrate your result with appropriate mathematical expressions.

(8 marks)

END OF PAPER

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Test 2 **Date: 12 April 2009** **Max marks: 40** **Weightage: 20%**

Answer ALL questions **Time allowed: 50 minutes**

Q1. A function rect(t/τ) is described by a unit rectangular pulse of width τ and centered around t =0. Express the signal x(t) shown in figure 1 in terms of the above function.

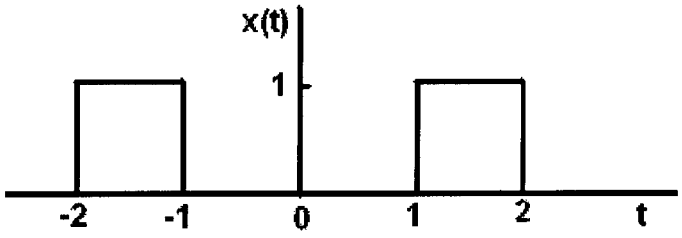

Figure 1

Hence find the Fourier transform of the signal x(t) in terms of sinc and cosine functions

(8 marks)

Q2. Obtain and sketch the inverse Fourier transform of X(ω) = sinc(ω) * sinc(ω), where the symbol "*" represents the convolution operation.

(8 marks)

Q3. A function g(t) is represented by $g(t) = rect\left(\frac{t+2}{2}\right) - rect\left(\frac{t-2}{2}\right)$.

(i) Graphically plot the integral function $f(t) = \int_{-\infty}^{t} g(t)dt$, given that f(-∞) = 0.

(ii) Also find the Fourier transform G(ω) of the function g(t).

(iii) From your answer to part (ii) above, and using the time integration property of Fourier transforms, determine the Fourier transform F(ω) of the function f(t) and express the result in terms of sinc functions. Hence determine F(0).

(12 marks)

Q4. Describe the function f(t)=sgn(t) using only unit step functions. From a knowledge of the Fourier transform of a unit step function, determine the Fourier transform of f(t).

(6 marks)

Q5 Find the Fourier series for x(t)=cos4t + sin6t in exponential form .

(6 marks)

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Test I **Date: 1 March 2009** **Max marks: 50** **Weightage: 25%**

Answer ALL questions **Time allowed: 50 minutes**

Q1. (a) Find the z-parameters of the circuit given in Figure 1.

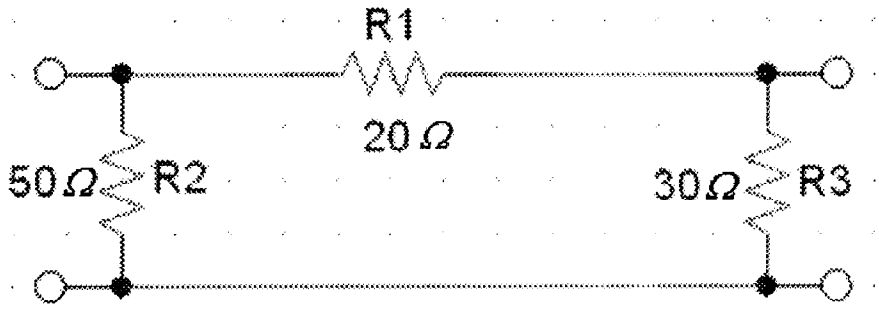

Figure 1 (10 Marks)

(b) Apply the parameter conversion method to calculate y_{11} and y_{22}.

(5 Marks)

Q2 Define h- parameters. For the 2-port network shown in Figure 2, evaluate h_{11} and h_{21}.

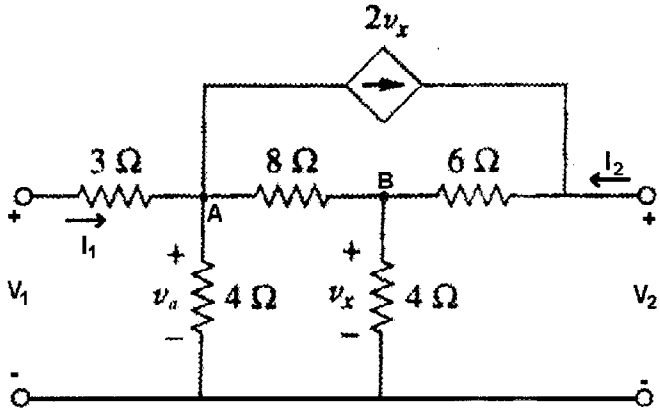

Figure 2

(10 marks)

P.T.O

Q3 . An RLC circuit configured as in Figure 3(a) has a transfer function

$$\frac{V_o(s)}{V_i(s)} = \frac{s^2}{s^2 + 4s + 24}$$

Determine the ratio *(R/L)*. Using the same component values, if a circuit is configured as shown in Figure 3(b), what will be its transfer function $\left(V_o'(s)/V_i'(s)\right)$?

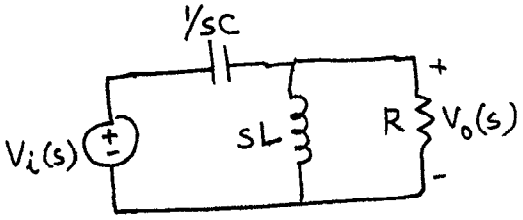

Figure 3(a)

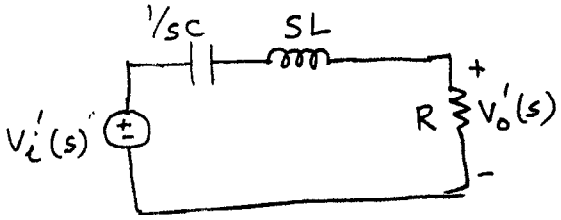

Figure 3(b)

(5 marks)

Q4 Draw the two-port network that has the following *y* parameters:

$$[y] = \begin{bmatrix} 1 & -0.5 \\ -0.5 & 1 \end{bmatrix} S$$

(5 marks)

Q5. A two-port network has the following parameters: $A = 10$, $B = 60\,\Omega$, $C = 5\,mS$, and $D = 4$ Determine the input impedance when the output is (a) open-circuited, and (b) short-circuited.

(6 marks)

Q6. State the sifting property of the impulse function. Using this property, evaluate the integral

$$\int_1^3 (2t^3 + 1)\delta(t - 4)dt.$$

(3 marks)

Q7 Determine and plot the even and odd components of the signal $x(t) = \sin\left(\omega_0 t + \frac{\pi}{4}\right)$.

(6 marks)

EEE C272 Circuits and Signals EEE II Year

Quiz 3 Time: 15 minutes Total marks 10. Weightage: 5%

Answer All Questions.

Q1. Given that the unilateral Laplace transform of $f(t) = e^{\lambda t}u(t)$ is $F(s) = 1/(s-\lambda)$, use the frequency differentiation property to find the function for which the Laplace transform is $1/(s-\lambda)^2$

Hence find the inverse Laplace transform of

$$F(s) = \frac{s^2 + 3s + 5}{(s+4)(s+5)^2}$$

(5 marks)

Q2. State and prove the frequency shifting property of Laplace Transform.

(2 marks)

Q3. Given the transform pair: $x(t) \Leftrightarrow \frac{2s}{(s^2 - 2)}$

Determine the Laplace transform of:

(i) x(2t)

(ii) x(t) * tx(t) where the symbol * stands for convolution

(3 marks)

EEE- C272 Circuits and Signals Quiz 2 Date: 29 March 2009

Max marks 10 Weightage 5%

Q1.

Signals g(t) and x(t) are as shown in Figure 1 for the interval t (0,1). X(t) is a sinusoidal signal. Find the component of x(t) in the form of g(t). What is the energy of the error signal?

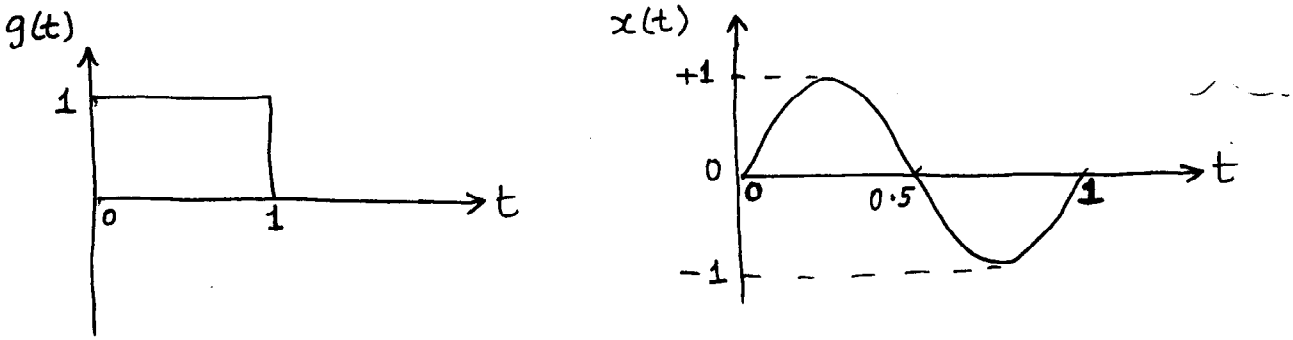

Figure 1.

(3 marks)

Q2.

A signal f(t) is represented in all three forms: Trigonometric series, Compact trigonometric series, Exponential series. How are the coefficients C_o, C_n and θ_n related to a_o, a_n and b_n? How are the coefficients D_o, D_n and D_{-n} related to C_o, C_n and θ_n? Here n is an integer that can have any value from 1 to ∞.

(3 marks)

Q3.

Find the Fourier coefficients a_o, a_n and b_n for a periodic signal x(t) asshown in Figure 2. Is any of the coefficients a_n or b_n zero? If so, why

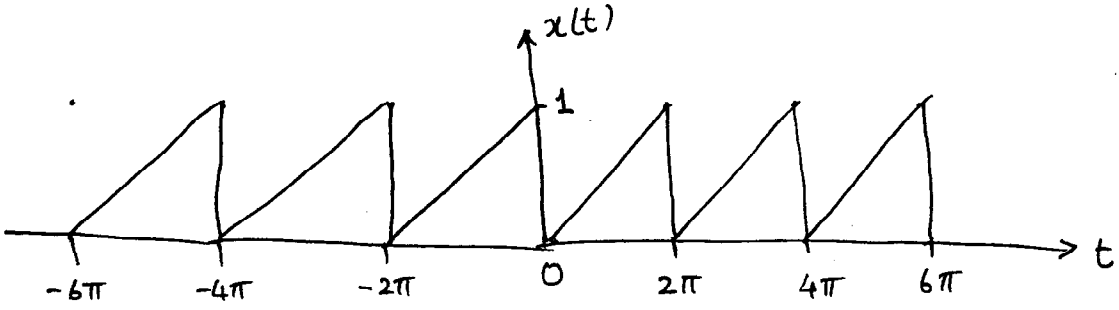

Figure 2.

(4 marks)

EEE C272 Circuits and Signals EEE II Year

Quiz 1 Time: 15 minutes Total marks 10. Weightage: 5%

Answer All Questions.

Q1.

For the 2-port network shown in Figure 1, determine the z-parameters.

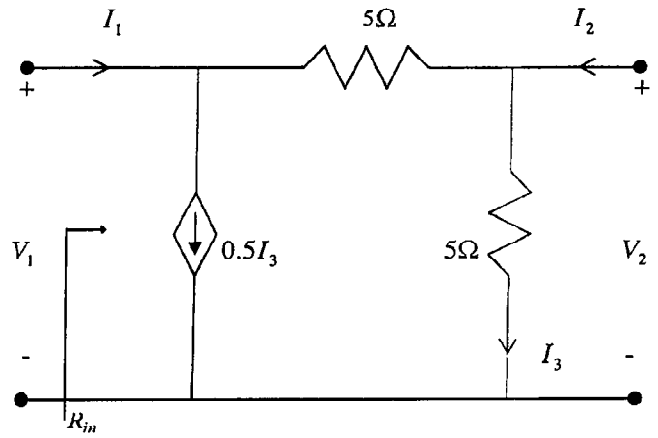

Figure 1

(8 marks)

The output port is now terminated by a load resistance R_L. If it is possible to vary R_L from 0 to ∞, determine the range of values of the input resistance R_{in} for the circuit.

(7 marks)

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II *4th YEAR EIE* Evaluation Component : QUIZ-1

INSTR UC 272 CIRCUITS AND SIGNALS

Max. Marks: 10 **Duration: 20 mts** **Weightage: 5%**

Find the Y-parameters for the circuit given