Networks and Systems

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Lecture-16
Worked Out Problems

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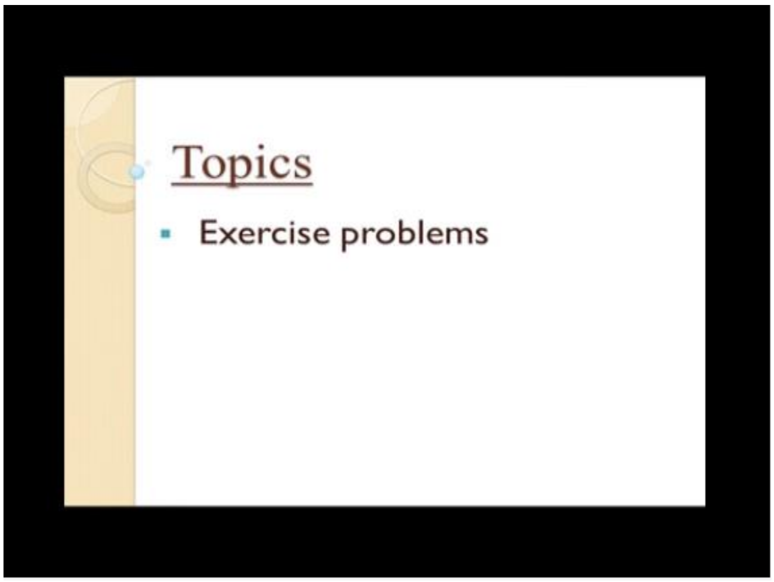

First question in the exercise is: Classify the systems given by the following equations as linear or non-linear, time variable or time invariant, continuous-time or discrete time.

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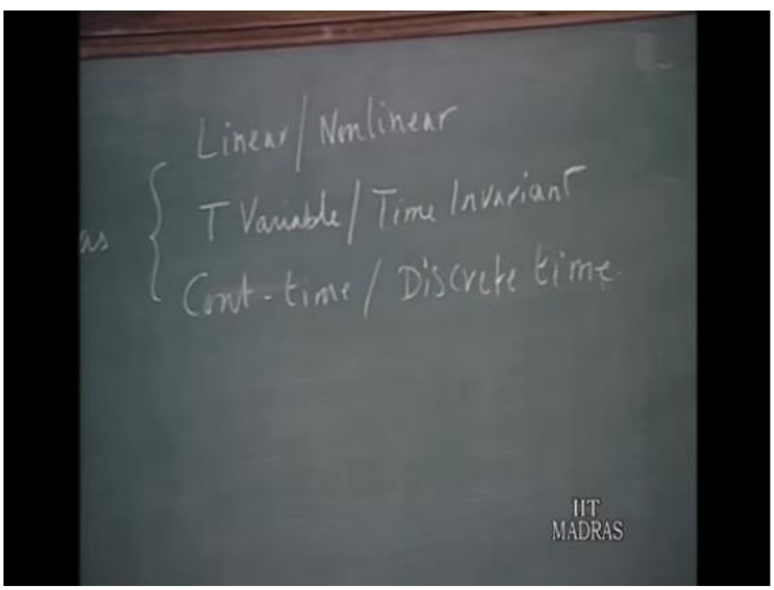

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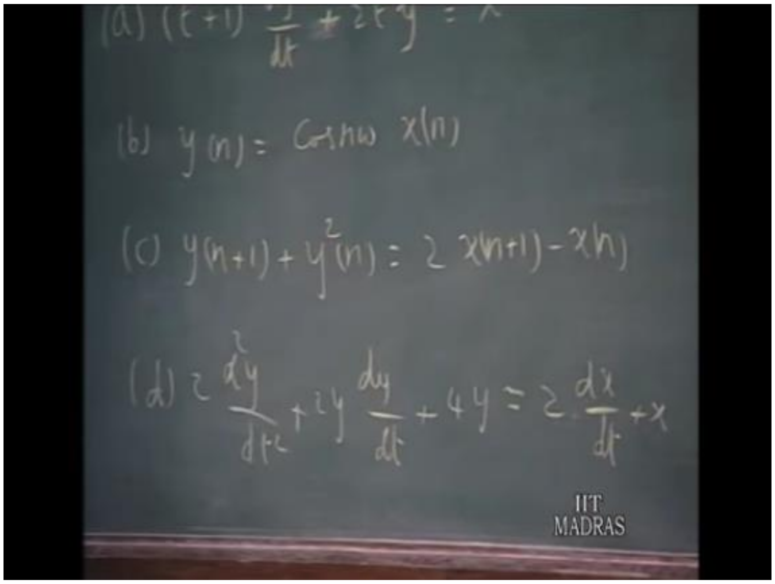

So, the equations are: a; t square plus 1 dy by dt plus 2t y equals x, b; y n equals cos n omega x n c; y n plus 1 plus y square n equals 2 x n plus 1 minus x n, d; 2 d square y dt square plus 2y dy dt plus 4y equals 2 dx dt plus x where the usual notation x represents the input and y the output. So, this is the first question.

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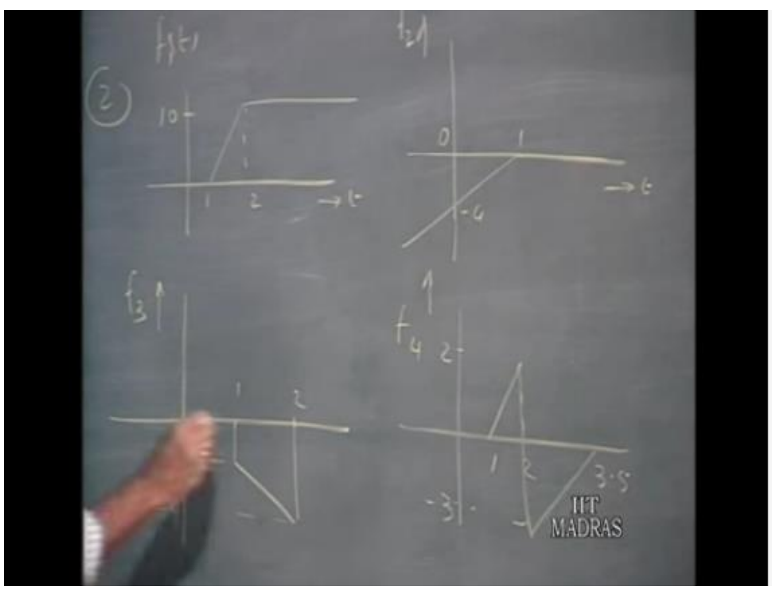

Second question; I give you a series of functions of time 1 2 this is 10. This is f 1 t. x axis is always is always time. f 2; 1 0 minus 4 and this is 0 from this is f 2. f 3; 1 2 like this, this minus 3 and here is minus 4. Everywhere else is 0.This is f 3. f 4; 1 this is 2 comes down, this is 3.5 and value here is 2 value is minus 3.

So, 4 functions of time are given to you. The x axis always in seconds; function of time and f 1 to f 4.

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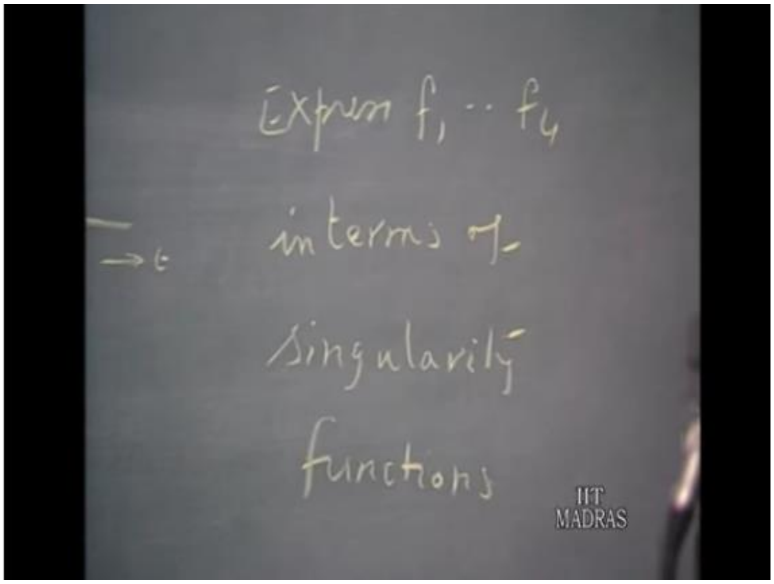

Express f 1 to f 4 in terms of singularity functions. So, in terms of step functions, ramp functions etcetera you express this find out expressions for this in terms of step functions and ramp functions, that is, the singularity functions. That is the second problem.

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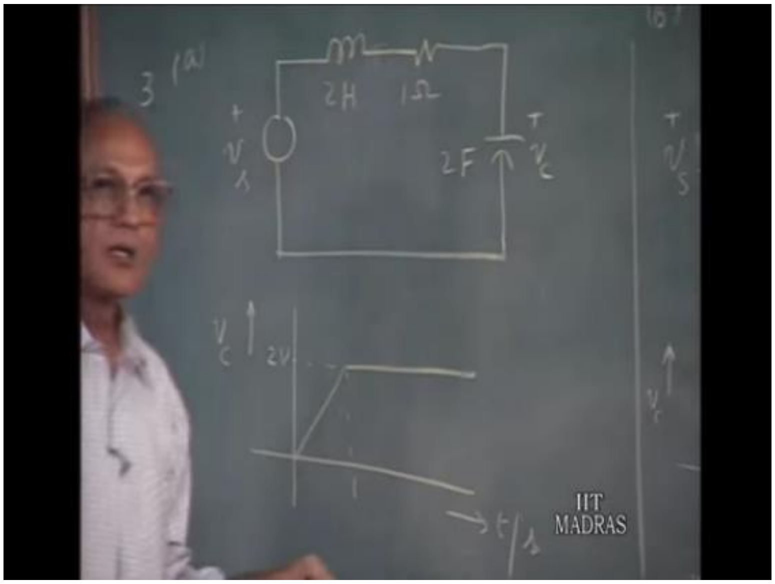

As a third example, let us take this circuit where source v s of unknown wave form is driving a circuit containing a inductor, resistance and a capacitor, values are given. V c has got this particular variation. The wave form of V c is given. Find V s of t and express this in terms of singularity functions and sketch its wave form v s of t in this given this circuit and this wave form of V c t; this is part a.

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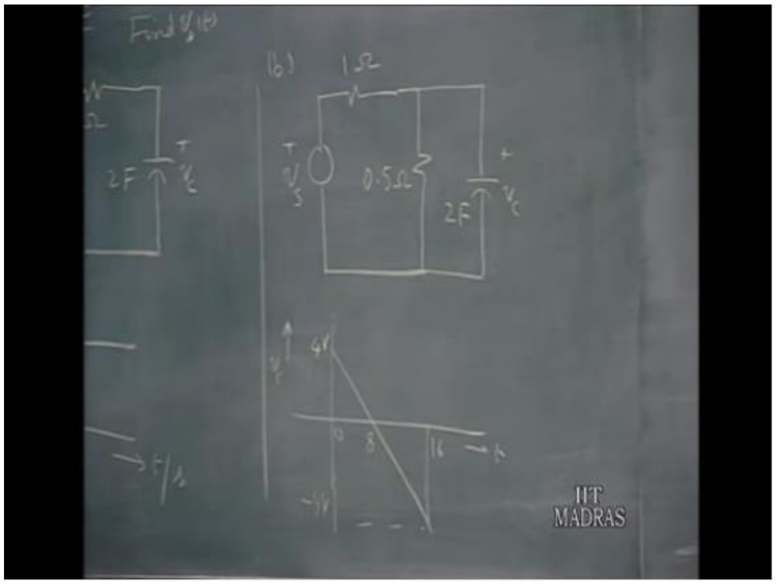

Do similar analysis for this circuit in which, again the value of the voltage v c is given by means of this particular variation; 4 volts to minus 4 volts. It decreases from 0 to 16 seconds and remains 0 for other values of time and if, this is the value and if this is the value of V c.

Find out the expression for V s of t in terms of singularity functions once again and sketch the form of V s in terms of using impulses, ramp functions and step functions. So, this is 1 problem which is exercised on using the singularity functions. So, these are 2 circuits which you can analyze using, the concept of singularity function.

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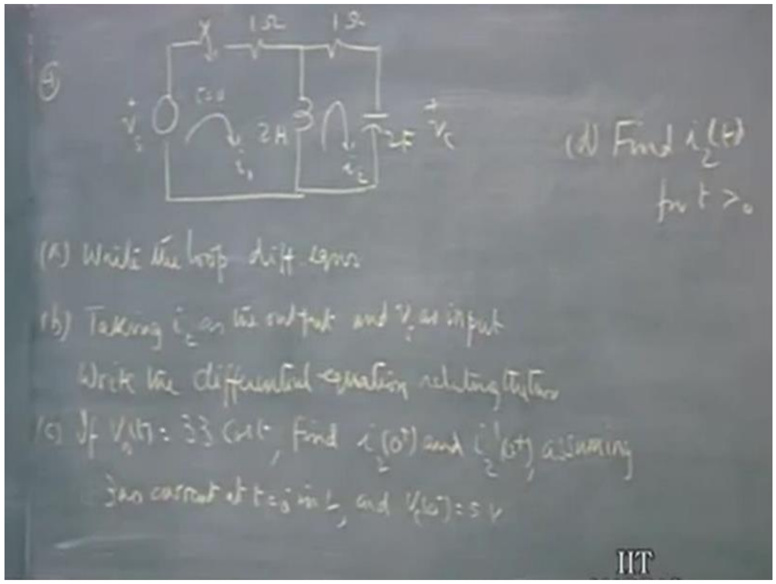

The fourth problem we have, let us take a circuit in which a switch is closed t equals 0 1 Ohm 2 Henrys 1 Ohm and 2 Faraday. We call this i 1 loop current call this loop current i 2. So, this is a exercise in differential equations. So, write the loop equations, write the loop differential equations in terms of: i 1 and i 2 and in terms of differential operator d. b taking i 2 as the output and d s as the input, write the differential equation relating the 2.

So, you have a second order differential equation relating i 2 as the output quantity y and V s as the input quantity x. c if, V s of t equals 33 cos t find i 2 0 plus and i 2 prime 0 plus, the initial value of the second current and its derivative, assuming 0 initial conditions at t equals 0 minus in the inductors and capacitance.

Assuming that the inductors and capacitance are initially uncharged or you know initial current. We will put this, assuming that assuming 0 current in 0 current at t equals 0 minus in the inductor and the capacitor voltage V c as 0 minus is 5 volts. And using this information, initial conditions, d find i 2 t for t greater than 0. So, that means this exercise in the use of differential equation approach, you have to find the initial conditions and finally, find the total solution for i 2 of t.

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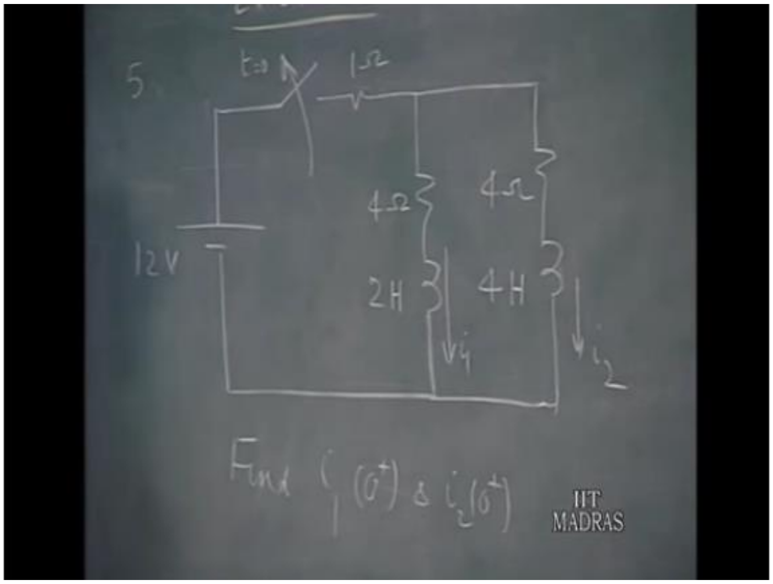

Fifth problem: 12 volts, we split this open at t equals 0 after a long time and you have a circuit in which, you have 2 inductors. This is 2 Henrys 4 Ohms. This is 4 Henrys 4 Ohms. This is 1 ohm i 1 and i 2. The switch is kept closed for a long time. So, inductors have some currents established in them and once the switch is open find i 1 0 plus and i 2 0 plus.

This is an illustration of the situations where, inductor currents can be discontinuous. So, using the principle that we are talking about, find out i 1 0 plus and i 2 0 plus. We assume that the initial conditions have been reached prior to the closure of the, when the switch is closed, steady state conditions are being reached and therefore, the inductors carry some current. Once it is opened out find out the new currents.

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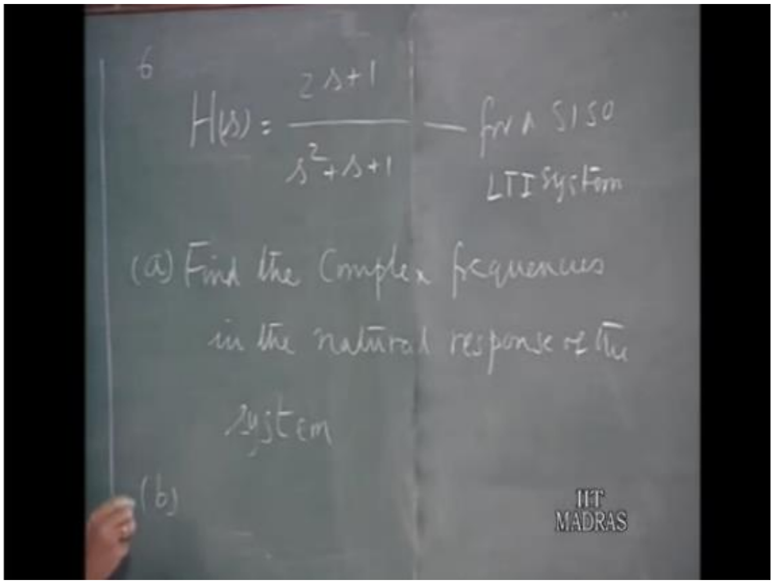

Sixth: the system function h of s is given by 2 s plus 1 divided by s square plus s plus 1 for a single input single output linear time invariant system. A linear time invariant system; single input single output system is this. Find the complex frequencies in the natural responses of the system. Find the complex frequencies in the natural response of the system.

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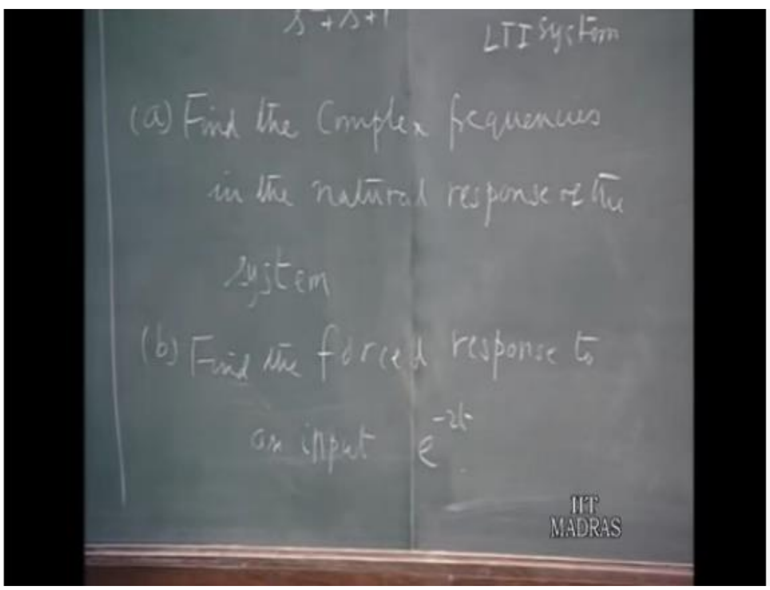

B) Find the forced response to an input e to the power of minus 2t. If the input is e to the power of minus 2t, what is the forced response of the system? That is 6.

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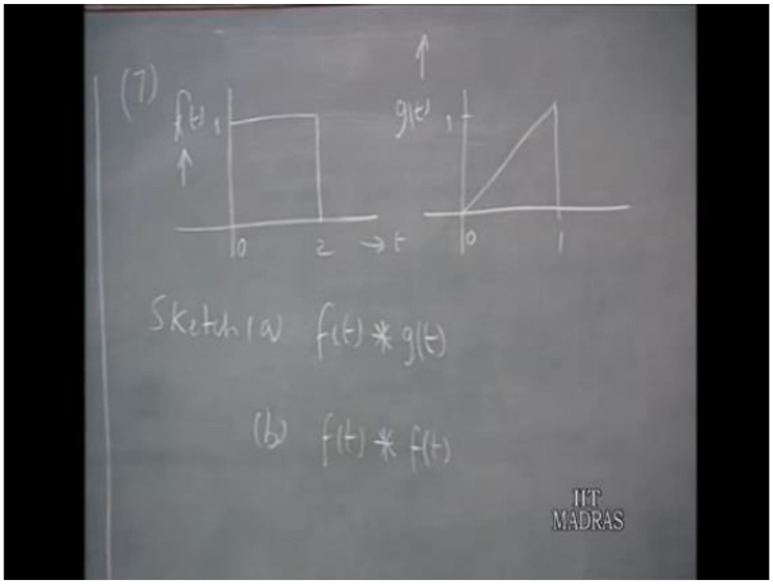

Seventh problem: we have 2 functions of time f t, 0 to 2 seconds which is a value of 1 and g of t which is a triangular pulse 0 to 1. This is 1 that is, g of t. These are the 2 functions f t and g t that are given to you. Sketch a f t convolved with g of t. The convolution f t and f of t. b f of t convolve with itself. So, it would advisable for you to work this out graphically. You can verify them by through analytical working, but a graphical procedure is more illustrative.

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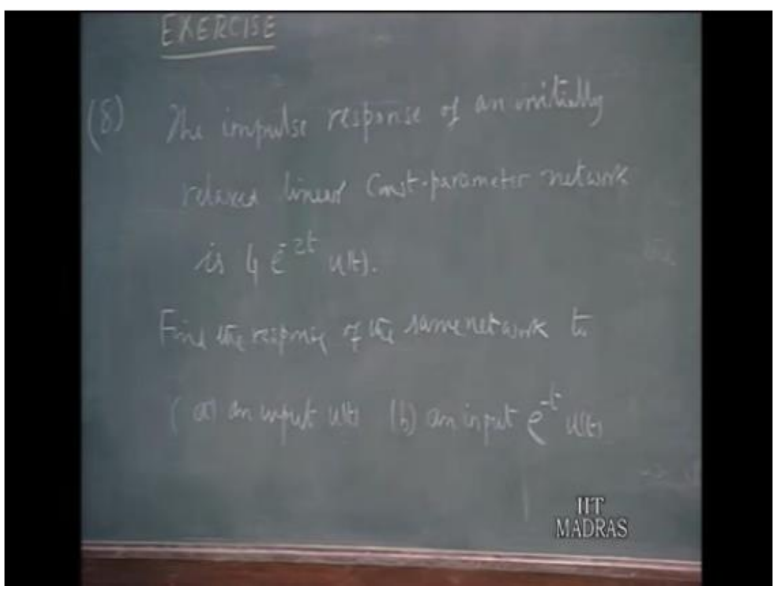

The last problem: the impulse response of an initially relaxed that means; there is no initial stored energy linear constant parameter network is 4 e to the power of minus 2t u t that means, this is h of t. Find the response of the network of the same network, find the response of the same network to a an input u t. That means find the step response. b an input e to the power of minus t u t.

That is taking this is h of t, use the convolution principle. Find the response to an input u of t that is the step response and find the response to a general input e minus 2 u t, assuming once again that the network is initially relaxed.