Networks and Systems
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Lecture-67B
Exercises

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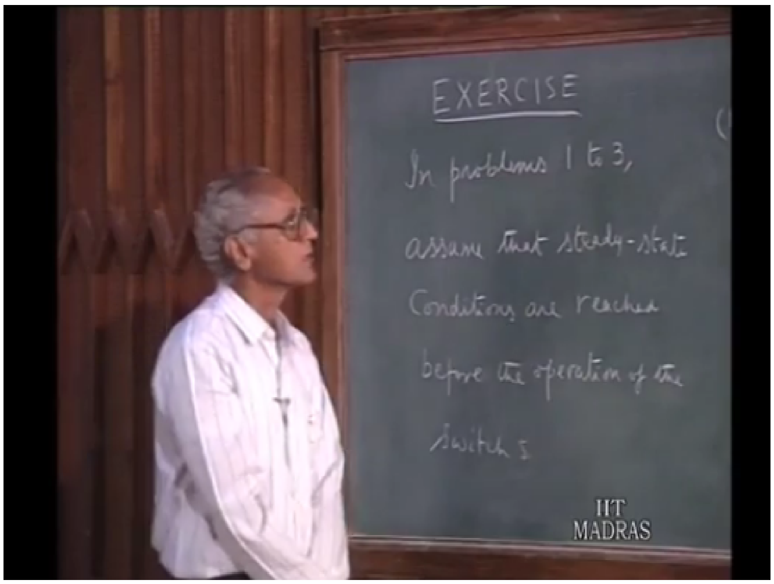

In the first 3 problems in this exercise we find the transients in a circuit operation of certain switches. So, we assume that in problems 1 2 3 assume that; steady state conditions are reached before the operation of the switch s. So, whether the switch s is opened or closed in the first 3 problems we assume that; before the operation of the switch the conditions in the circuit have reached steady state.

So, that will enable as to find out the conditions at t equal 0 minus in the various circuits that we are going to investigate.

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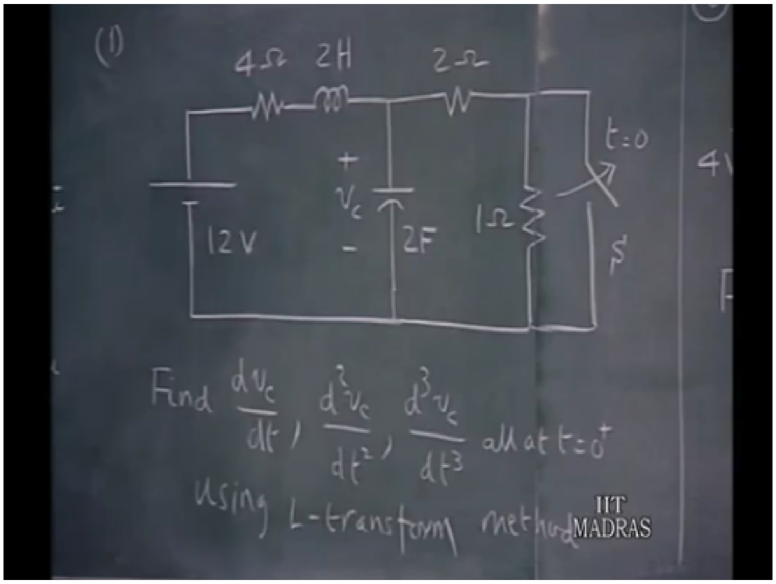

First problem. So, in this problem you are having a 12 volts vc source connected to circuit consisting of a 4 Ohms resister 2 Henry inductor 2 Farads capacitor in shunt and the 2 Ohm resister and a 1 Ohm resister. Now, this switch s is kept closed for a very long time since, steady state is reached and then it is opened t equals 0.

Now you are asked to find out the capacitor rate of change of capacitor voltage dvc dt d square vc dt square the third derivative d cube vc dt cube 0 as a function of time. All of them evaluated t equal 0 plus and how do you do this use the Laplace transform method. So, we are not interested in the time domain behavior of vc of the derivatives.

We are interested in the values of the first second and third derivatives of the vc evaluated t equal 0 plus. Now, if you have to do this in the classical differential equation approach in time domain becomes little trepan complicated, but. The Laplace transform method gives as very simple way in which you can calculate this and this problem illustrate this technique.

So, all you have to do is using the t equals 0 minus conditions of vc set up the transform diagram for this and arrive at the expansion for vc of s the Laplace transform of the capacitor voltage once, you have the Laplace transform of the capacitor voltage you can also find out the Laplace transform of the derivative of the capacitor voltage, the second derivative of the capacitor voltage, third derivative of the capacitor voltage.

All in the Laplace transform domain. But, you do not have to find out the Inverse Laplace transform to evaluate vc or vc prime vc double prime or vc triple prime only once you got the Laplace transform of the respective quantities you apply the initial value theorem and find out the values are t equals 0 plus.

So, this is an application of the initial value theorem so, as we said the initial value theorem will always give you t equals 0 plus values. So, you have to do apply that theorem and find out respective values you do not have to find out the Inverse Laplace transform of any 1 of this quantities.

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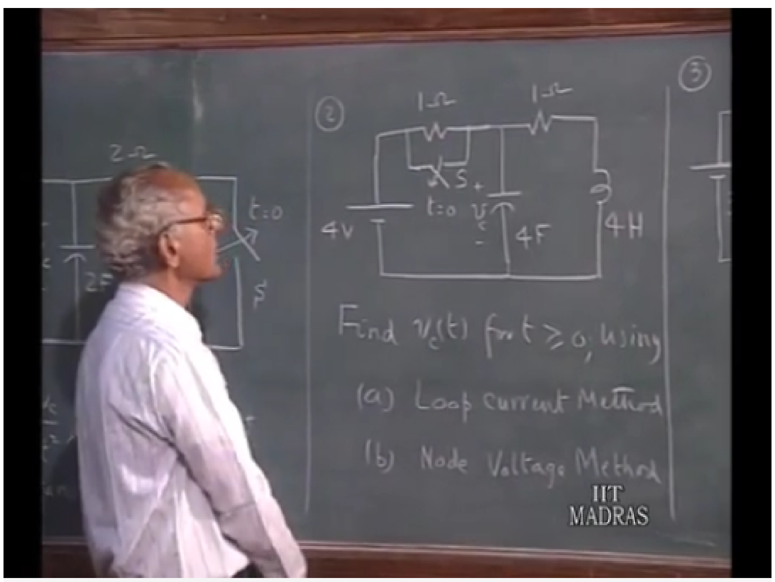

Second problem is this: in which we have a 2 loop circuit consisting of an inductor and a capacitance so on. The switch is kept close for a very long time that enables you to find out the initial condition respect to the capacitor as well as the inductor. And you use them the transform diagram it 4 volts 1 Ohm, 4 Ferrates, 1 Ohm, 4 Henries.

And you are asked to find out find vc of t for t greater than are equal to 0 use 2 methods once, you have the transform diagram. We analyze the transform diagram on the loop basis using the loop current method or the node voltage method. And we get solution for vc of t by both methods conclude and both should be the same when you are using the node voltage method.

As I mentioned when you replace this initial conditions on the capacitor by means of an equivalent source is the voltage across those 2 nodes which represents capacitor voltage in the transform domain. So, you keep that in mind; in calculating the capacitor voltage in node voltage method. So, this is an exercise in using the transform diagram, for solution of another response quantities which happens to be vc of t in this particular example. So, you can take this down.

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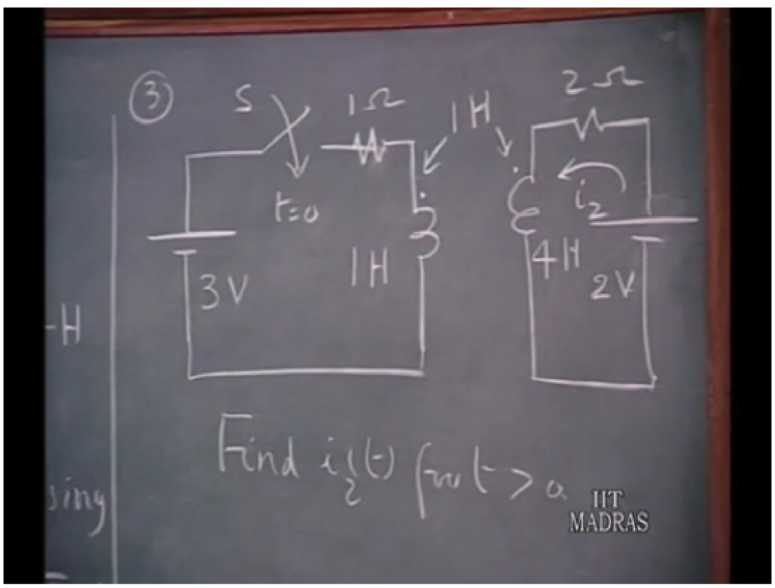

Now, the third example, is concerns use the transform diagram approach where mutual inductance. So, you have a 3 volts source connected to a series circuit of 1 Ohm and the primary coil having a self inductance of 1 Henry. It is couple to a secondary coil of 4 Henry self inductance the mutual inductance of 1 Henry, this is the mutual inductance.

This is the self inductance of foil 1, this is a self inductance of coil 2 and the secondary circuit is close to a 2 volts dc cell this is the source and the 2 Ohm resisters this is the situations and when the switch is kept open naturally only current will go through this when we know current here.

So, i 2 0 minus you can find out and put appropriate initial conditions in the transform diagram. And once, the switch is closed for this circuit is also completed you have got a current here and current here and you write down the appropriate loop equation and solve for i 2 of s from that; find i 2 t for t greater than 0.

So, you have to use the replacement of initial conditions in couple coils equivalent sources you can have use current sources or voltage sources and find out the appropriate solution.

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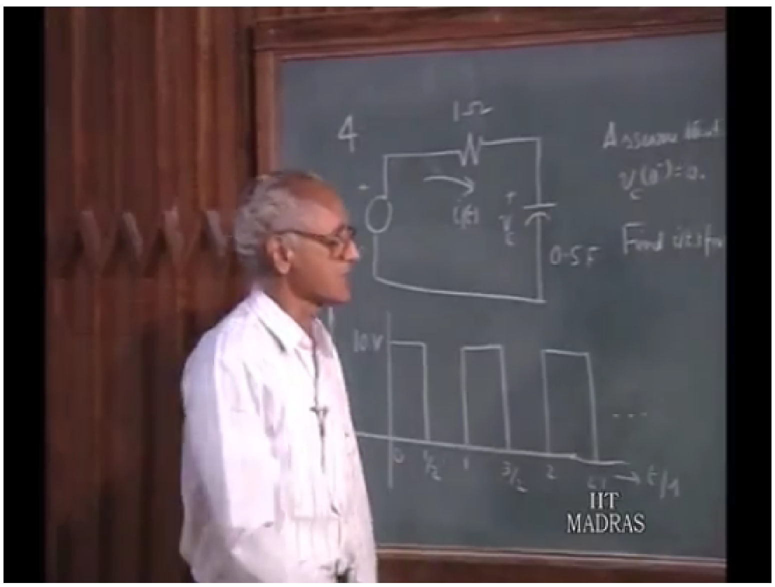

Problem number 4, we have a series circuit containing a resistance or 1 Ohm and a capacitor of 0.5 Ferrates and this is connected to a voltage source vs which has got a discontinuous character, it a set of periodic pulses and so on, so for this is the variation of this vs, it has the pulses have a amplitude of ten volts this is t in seconds.

So, it is a pulse frequencies 1 Hertz and the pulse duration in each period is half a second 3 by 2 and so on, so for extra. So, this is the v of s and assume that if this a capacitor voltage vc 0 minus is 0 that is, the pulse is applied at t equals 0 first pulse at the time the capacitor voltage is 0. Now, you are asked to find out the current.

So, you are asked to find out expression for the current in the network on the application of the discontinuous voltage source this is the periodic voltage source starting from t equal 0. So, you must find out the Laplace transform of that; use that get an expression for i of s and interpret the i of s you will have e to the power of s factors also in that.

When you find out the Inverse Laplace transform you get some delayed versions of certain quantities interpret them suitably and get give an expression for i of t in the final expression in the final result.

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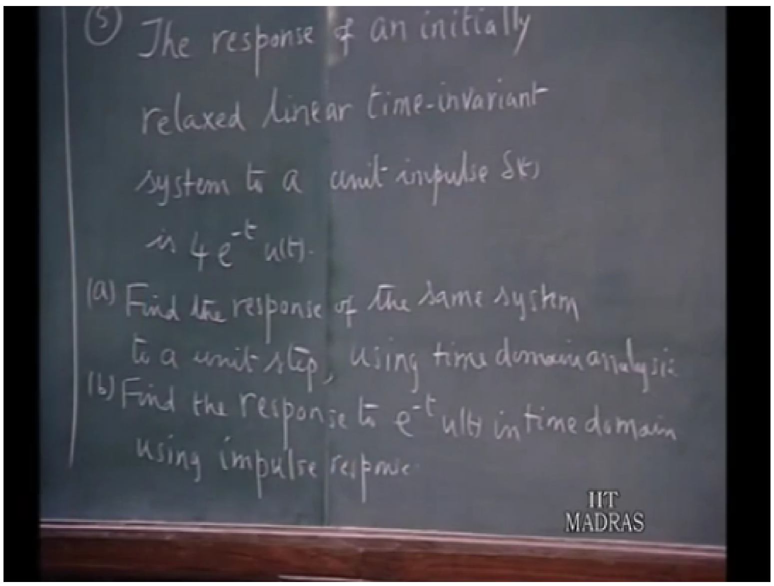

Fifth problem involves the application some of the system concepts that been talked about. So let me, write this down there are the response of any initially relaxed linear time in variant that means; constant parameters system to a unit impulse delta t that is applied a t equal 0 is 4 e to the power of minus t ut that means; the impulse response the system is given.

And you are asked to find a series of quantities fins the response of the same system, find the response of the same system that is: once again assuming to be initial relaxed to unit step using time domain analysis that is: you try to find out the convolution of the step and the impulse response b find the response to e to the power of minus t ut in time domain that is: do not use Laplace transform.

Find the response to this in time domain using impulse response as the difference. So, you use the convolution integral using h of t.

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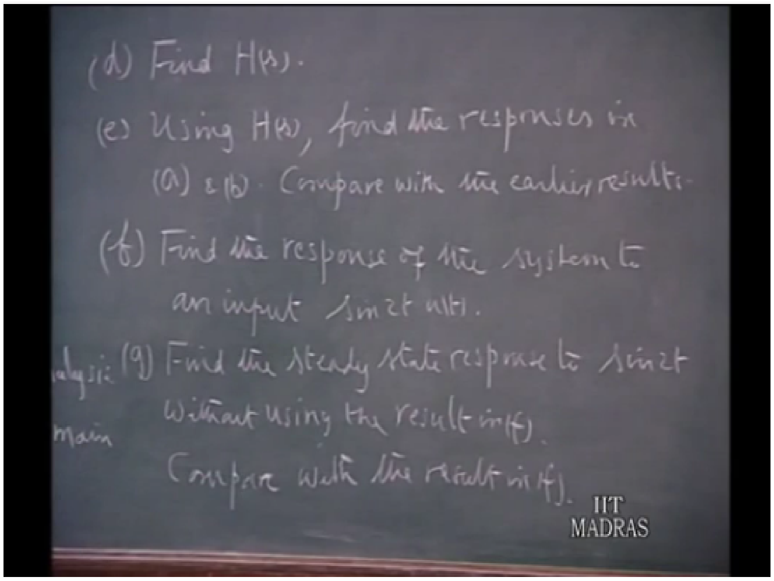

Then c: Find the solution in b using step response. So, in time domain once again, we use the convolution integral involved in this illusion response a of t d find the system function h of s e using the system function h of s, find the responses in a and b that is: use Laplace transform method this time earlier you will use the convolution integrals.

Now, using h of s find the response in a and b and compare with earlier results, f find the response of the system to an input sin 2 t ut. So, the input is a sinusoidal applied t equals 0 find the response of the system to be input of course, you use Laplace transform method for this quite convenient to use g, find the steady state response to this input sin 2 t without using the result in f.

So, you are asked to find out forced response for the system sin 2 t, with the forced response with an input sin 2 t also happens to be steady state response. Because is the steady the sinusoidal is the steady state characteristics in does it the amplitude is maintain.

Therefore, the forced response to sin 2 t is also the steady state response and that portion of the total response that; obtained in f you obtain independently using the frequency response function and compare with result in f that means; whatever, in the total response the particular portion corresponding to the steady state behavior must agree with this compare with the result in f.

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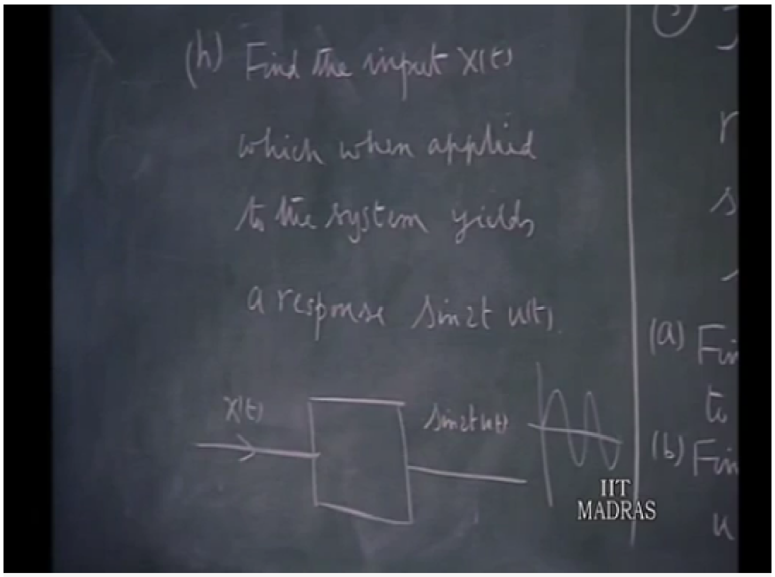

Then lastly h: Find the, input xt which, when applied to the system yields a response sin 2 t ut. So, what you want is you determine what type of excitation should be given to the system. So, that the output is sin 2 t ut that means, it must start from 0 like this. So, that is the output so, what type of input should be obtained in order to find out get this output.

So, this last problem illustrate: the ideas of system use the Laplace transform to the system analysis that has discussed in the last 2 lecture. It is quite a comprehensive package of questions that you are having. It covers more or less all the aspects that we discussed.