Dear students, welcome to the paper on analog and digital electronics.In today's session of this paper, I will be dealing with the Section 2 of this paper in the form of digital electronics that the paper code is PY C106, and this is the paper that you're going to be doing.for this Academic year. The unit title is number system logic and the module that I'm going to be dealing with today is decoders and encoders, and it pertains to the model module #9. Let me introduce myself before we go onto the module. I am Doctor Ramu murthy from the Department of Physics at Dhempe College of arts and science, Miramar, Panaji, Goa.

A quick outline of the model that we're looking at today. I will be looking at what's the meaning of the decoder. the BCD to decimal decoder. As an example, we're looking at the 1 of 4 decoder, and finally we'll wind up this module with what is called as an encoder. Quick look at the outcome. So at the end of the session, all of you students must be in a position to define what a decoder means, and therefore draw the logic circuit for one of four decoder as an example, although the one or 16 decoder is the most common decoder you come across, however it would be. Easier to understand the one of four decoder before you can actually extend yourself to the one of 16 decoder and finally ended up with the definition for an encoder and a decimal to BCD encoder, right? So let's first look at the decoder. So what's the meaning of the decoder? Is the question that we would like to ask ourselves. so having seen the multiplexer and the demultiplexer, the decoder is nothing but A modified version of the Demultiplexer, and therefore when you look at the definition for the decoder, we say that the decoder is similar to a demultiplexer with the result of only one exception. And what is the exception here? the exception here is. There is an absence of an input data bit which figures in the case of the demultiplexer. So which means that if there is an absence of an input data bit. The only possible inputs that are available for the digital circuit in the form of the decoder are the controls, right? So what you see on the right hand side of the screen iis a very simple example of a 1 to 4 decoder. Now when you say 1 to 4 decoder, what does it mean? it means that if you're looking for a one to four decoder, it tells you that at any given time it's only one of the four outputs. that will result Based on the given combination of your control inputs. So in the case of a 1 of 4 decoder, you first need to find out the number of inputs that you require. So if you look at the circuit Carefully , the circuit comprises four controls So how do we come up with these 4 and gates? you just use the basic formula 2 raise to N where N is the number of gates has their own outputs in the form of YO, Y1, Y2 and Y3., and your control inputs will now be A&B along with your compliments, A compliment and B complement.So what the decoder means is that at any given time, only one of your AND gates is going to be enabled, while the remaining three AND gates are going to be disabled and therefore what's going to happen is going to result in a single output based on the combination of the control inputs that you give. So let's take an example.So what if you have 4 controls ? I have a combination of AB equal to 00. So if you have a be equal to 00, recollect that an NAND gate is enabled only when its inputs are high and therefore if you have an input in the form of a AB equal to 00, you have to lookout for a combination of A compliment and B complement and therefore if you look very carefully at the one of four decoder you realize that the 1st AND gate has an input in the form of A compliment and B complement and therefore when you feed the control inputs in the form of 00, you find that only the first AND gate is enabled while the remaining three AND gates are disabled. And therefore an input combination of A B = 0 zero, will give you an output in the form of Y0. On the other hand, if you take a second example of an input. So let's say if A B equal to 11,

then what are you looking out for? So if you look very carefully at the circuit, if you have an input combination in the form of A B equal to 1 1, then you find that the last AND gate has an input in the form of 1 be equal to 1 while all the remaining three and gates OK will have either one of the inputs that is low and therefore they will be disabled. And therefore the circuit will end up with an output in the form of Y-3 when you have an input combination of A B equal to 11. So this is a pretty easy example of a 1 to 4 decoder. However, you can extend this to one of 16 decoders where you would have 4 control inputs. and your compliments in the form of ABC and D and their compliments. Remember that if we were looking for one of 16 decoder, it would have 16 different gates. And therefore you will have 16 different outputs extending from Y0 to Y16.So the one of 16 decoder is the most common decoder that you're looking at although we took an easy example in the form of the one of four decoder to understand. to understand how the digital circuit in the form of a decoder works. OK, let's go to the BCD to decimal decoder. Now what does the BCD stand for? the BCD is nothing but an abbreviation for the Binary coded decimal and what the BCD does is, it expresses each digit in a decimal number in terms of his nibble equivalent. Now what's the meaning of nibble equivalent? It is a combination of four bits which means that if you're looking at a nibble equivalent in general it means 4 bits in the form of XXXX is what is called an nibble equipment.

So what the BCD to decimal decoder does is it converts each digit in a decimal number to, it's nibble equivalent. So let's take an example. So you have an example on your screen, in the form of a decimal number 429, so if this is your decimal number 429, what would be BCD to decimal decoder?
It would pick out each of the digits in the decimal number 429 and express each of the digits in terms of the nibble . So if your number is 429, you split up the number individually as 4, two and nine, and then what the BCD to decimal decoder would be able to. It would decode it, will decode and express each of the decimal numbers. OK, each of the digits in the decimal number in terms of his nibble equivalent and therefore the nibble equipment of 4 is 0100 the nibble equivalent of 2 is 0010, while the nibble equivalent of nine is 1001. On the other hand, if you take a second example in the form of four digit decimal number, let us say 8963. then what would the BCD to decimal decoder do is going to break up this decimal number 8963 into 4 digits, namely 8-9, six and three and express each of the digits in terms of the nibble equivalent..So therefore if you look at the four digits individually right, the digit 8 would have a nibble equivalent in the form of 0100, the digit nine would have a nibble equivalent in the form of 1001. Then the digit six would have nibble equivalent to the form of 0110, and finally the digit three would have a nibble.Equipment in the form of 0011.So this is what the binary to decimal decoder does, right? So if you have a decimal number, So what it does is it breaks up the decimal number into his individual digits and expresses each of these digits in terms of their nibble equivalent.

On the other hand, if you look at the one of 10 decoder, what's the meaning of the one of 10 decoder? So the one of Ten decoder is a very simple example of decoder. So one of 10 decoder would work. In simple terms tell you that if you have one of 10 decoder circuit that is comprised of ten AND gates at any given time you will find that only one of these AND gates is enabled. Depending on the input combination of the control inputs, thereby giving you a corresponding. Output, So what do you see on the right hand side of your screen is essentially One of 10 decoder circuit.So the one of 10 decoder circuit now comprises of 10 different AND gates such that each of them have their outputs in the form of YO, Y1,Y2,Y3,Y4,Y5,Y6,Y7,

Y8,Y9 .Please remember that you got to include the zero, so zero to 9 gives 10 different combinations of your input in the binary system so the zero is important.The Zero is an important number in the number system. So when you're looking at a 1 of 10 decoder, your output should now extend from Y-0 to Y9. If you're looking at a one of 16 decoder, your outputs must be inclusive of zero and must extend from Y0 to Y15, which is 16 different combinations of inputs.So what you see on your screen on the right hand side is one of 10 decoders. What about the inputs? the inputs are again the controls in the form of ABC and D and their complements in the form of A compliment, B complement, Compliment C and D compliment. So let's take an example right? So let's say your input combination is ABCD is 0011. Then only the Y3 AND gate has all inputs high and hence only the Y3 output is high.

If you take a second example ABCD equal to 1000. Then what would happen? You have to lookout for an input in the form of ABCD equal to 1000. You have to look out for an AND gate that has an input A ,B complement, C compliment and D compliment and therefore if you look very carefully at the circuit, you have the 9th AND gate that has an output Y8 and has an input combination A ,B complement, C complement and D complement and therefore what happens is it's only the 8th AND gate that has an output of Y8 that will be enabled while all the other end Gates will be disabled. An important thing to note is if you look at the subscript of the the output, for example, Y 8, The subscript of the output is nothing but the binary equivalent and therefore you see the subscript of the high output equals a decimal equivalent of the input BCD digit and hence you have a BCD to decimal decoder. and finally we have what is called as an encoder. So what does an encoder do? The encoders essentially a circuit that converts an active input signal in the form of a decimal number.Into a coded output signal in the form of a binary number, and therefore if you look at the block diagram for an encoder, it has several input combinations or it has several input lines,several output lines and this is what the general block diagram for an encoder would look like. On the right hand side is what you see in the form of a very very simple
digital circuit for an encoder. So what you have? So you have your input signals all in the form of an active input signal in the form of decimal numbers, extending from zero right up to nine and all these inputs are inputs to the four OR Gates having their outputs in the form of ABC and D. Let us say you apply a signal in the form of the button #3 that is pressed. Then what would happen if you look very carefully? It's only the C&D the inputs to the OR gates are enabled while all the other inputs

are disabled and hence you would have an output in the form of ABCD equal to 0011, right?
. Right, dear students.If you wish to share the images, you can always get in touch with me. OK, at my email address.

The references are here for you to see.

Thank you.