Dear students, welcome to the subject of physics and the paper that I'll be looking at today is the paper on analog and digital electronics.This is a paper in Semester 5 and the paper code is PYC 106.

I will be looking at the unit title called Transistor Multivibrators.And the module name that I'm dealing with is by Bistable multivibrator. Let me introduce myself quickly. I'm doctor Ramu murthi, an associate professor from the Department of Physics at Dhempe College of Arts and Science and my email is what you see on your screen. The outline of this model would be to introduce you to the bistable multivibrator circuit. And then we'll follow it up with the circuit diagram and working of the bistable multivibrator. And we then look at the introduction to the Schmitt trigger circuit, which is nothing but an extension of the bistable multivibrator in the form of the part one. And we end up with the circuit diagram and the working of this Schmitt trigger circuit. At the end of the session, all of you students must be able to explain the basic principle of operation of the given Bistable multivibrator circuit, Understand the working of the circuit as a divide by two counter. Explain the principle of operation of this circuit and finally understand its working and analyze the output in the circuit. So let's quickly look at the introduction to the bistable multivibrator. Now what's the bistable multivibrator circuit?

A quick recap of the two multivibrator circuits prior to the bistable multivibrator in the form of the astable and the monostable. So the astable multivibrator essentially is a circuit that has two quasi stable states while monostable multivibrator is a circuit that has one quasi stable state and one stable state and therefore you see when you move to the circuit called bistable multivibrator, bistable multivibrator has two stable states. and the circuit remains in this stable state unless and until you apply an input signal in the form of a trigger. In other words bistable multivibrtaor in simple terms can be said to be a circuit that has no Stable states. and has just two stable states.Therefore, very importantly,the bistable multivibrator is known as what is called as a flip flop.

A very important characteristic of the bistable multivibrator. Is that it maintains the given output state unless and until you apply an input trigger pulse that will force the circuit to change states of the two transistors. Hence requires two external triggers or trigger signals before it can return to its Original state and that's the reason the bistable multivibrator finds extensive use. in applications such as computer circuits.

A quick look at the circuit diagram and the working of the bistable multivibrator. Remember that the circuit just like the astable and the monostable is made up of two transistors in the form of Q1 and Q2, such as the two transistors function as switches. so when the switch is on,its output is low, and when you switch is off, its output is high, right? So what you see on your screen are two versions of the bistable multivibrator circuit. One is very simple.and the other is a slightly more expensive version of the bistable multivibrator circuit, wherein you have the trigger input circuit. As I said it has two stable states.in the form of either the transistor Q1 ON and the transistor Q2 off, or the transistor Q1 off and the transistor Q2 on. So let's let's make a basic assumption to look at the working of the bistable multivibrator circuit. So let's presume that the transistor Q1 is on and the transistor Q2 is off to begin with.

When you power the circuit. So when the transistor Q1 is on, what's going to happen? Remember that the two transistors function is switches, so when the transistor Q1 is on, its output is low and when the transistor Q2 is off, its output is high and therefore the circuit remains in this stable state Q1 ON and Q2 off OK until and unless you apply an input trigger signal, so this is the first stable state of your bistable

multivibrator. Now if I now wish to Switch the states of the transistors from Q1 on and Q2 off to Q1 off and Q2 on. I now need to apply a single input trigger pulse across the base of the transistors and therefore if you look at the extended version of the triggering circuit of the bistable multivibrator, you're basically applying an input trigger pulse across the base of each of the transistors., such that the triggering circuit essentially comprises of biasing diodes. And capacitors in the form of C1 and C2. So this is what you're doing. So when you apply your first trigger pulse you're switching the state of the transistor. You're switching the state of the transistor from Q1 on and Q 2 off to Q1 off in Q2 on.When I apply a second trigger pulse ,I'm switching the circuit back to its initial state of Q1 off of Q1 and Q2 off OK,and therefore what it means is if you want to switch this state of the transistor, the circuit requires two external triggers or signals before it can return to its original state.so that's what you have. So this is what you see in the case of the bistable multivibrator circuit.

That the circuit has two stable states in the form of either Q1 ON and Q2 off, or Q1 off in Q2 on, if the circuit is in the first stable state, Q1 ON and Q2 off. I first apply a single input trigger pulse across the base of each of the transistors and that will cause the transistor to switch state from Q1 on and Q2 off to Q1 off in Q2 on. When I apply a second trigger pulse, the circuit will go back to Its initial state of Q1 ON and Q2 off right, and therefore you see the bistable multivibrator circuit is a very, very simple circuit to understand in the sense that there is an absence of coupling capacitors and therefore the circuit merely depends on the application of an input trigger pulse. So an important aspect of the bistable multivibrator is that it is also known as the frequency divider circuit and the reason the bistable multivibrator is known as a frequency divider circuit.Is because you see the frequency of the output is ½ the frequency of the input trigger pulse and therefore and therefore the bistable multivibrator is also known as the frequency divider, right?

So let's move on to the next circuit, called the Schmitt Trigger circuit. Now the schmitt trigger circuit is nothing but an extension of the bistable multivibrator in the sense that this circuit is basically a bistable multivibrator such that it has two stable states and its outputs are controlled basically by the application of an input signal and therefore you see on account of this property of the Smith trigger

it finds an extensive use as a level detecting circuit.So let's quickly look at the circuit diagram for this circuit., so the Schmitt trigger circuit, just like the bistable multivibrator, has two transistors in the form of Q1 and Q2 .However, there is a very important difference in this circuit that is, the schmitt trigger circuit no longer has the collector coupling as you see in the case of the astable, monostable and bistable.In fact,in this circuit you now have the emitters of the two transistors coupled together through an emitter resistance in the form of Re ,and the input to the transistor Q1 is driven by an input signal in the form of Vin and final output is across the collector of the transistor Q2. Now with the absence of an input signal in the form of Vin equal to zero,what happens right? So in the absence of an input signal across the transistor Q1,the transistor Q1 will remain off while the transistor.Q2 will go on and therefore what's going to happen.The final output of the circuit will now be an output in the form of saturation voltage that wen see in the form of Vcesat.

This output is essentially nothing but your saturation voltage and therefore you see.This is the first stable state of the circuit that when Vin equal to zero in the absence of an input signal,the transistor Q1 is off.The transistor Q2 is on. Circuit is at saturation voltage that we denote as equal to Vce.

So now when the transistor Q2 is on,remember that you have a current Ic2 that flows through the collector resistance R L2 and through the transistor and down through the emitter coupled resistance RE and therefore you see every time you have a current.Ic2 that flows through the emitter coupled resistance you will have a potential drop across the emitter in the form of Ve2.Now remember we're writing it as Ve2 because.The potential drop occurs are in the form of Ve2 corresponds to your current IC2, that is flowing through the emitter coupled resistance. And if you wish to calculate therelation for the collector current Ic2 that flows through the transistor Q2 in the first stable state Q1ON and Q2 is off, You merely make use of the Kirchoff's voltage law and you can write down an equation using the voltage law for the output half of the circuit across the transistor Q2.When you do that,you end up with a relation for the collector current in the form of Ic2 equal to VCC minus Vcsat divided by RL2 + Re.

So if you see very carefully the collector current.Ic2 depends entirely on your emitter coupled resistance in the form of Re,which means that if I wish to change the emitter resistance Re,you find that your collector current IC2 is going to change. So in the absence of an input signal,the first stable state of this schmitt trigger circuit is Q1 off and Q2,is on, and when Q1 off in Q2 on, our output of the schmitt trigger circuit is now we see saturation. And because the transistor Q2 is on,you now have a collector current IC2 that flows through R L2.And through the transistor Q2 down through the emitter,coupled resistance in the form ofAri and therefore you are now in aposition to write down an equationfor this collector current in the form of IC2 given by VCC minus VCsat divide by RL 2 + R E and remember that the potential drop across the emitter coupled resistance is now Ve 2 equal to IC2 times Re ,so quick recap of this schmitt trigger circuit.So in the absence of an input signal Vin, the transistor Q1 is off and the transistor Q2 is on.And when this happens, your output is at saturation, you have a current IC2 flowing through the output half of the circuit, and you have a potential drop in the form of Ve2 equal to IC 2 * R E. So if I wish to switch the state of the circuit from the first stable state Q1 off and Q2 on, I need to now apply a signal across the input of the transistor Q1 and the signal that you're going to apply is in the form of a sine wave signal across Q1. So to switch the stable state of the circuit from Q1 off and Q2 on to the next stable state in the form of Q1 ON and Q2 off. You merely need to apply a signal across Vin and this signal mean is essentially a Sine wave signal that we apply across Q1.

The references that we are using for the bistable multivibrator circuit. and the Schmitt trigger circuit is a book authored by Alan Mottershead called Electronic Devices and circuits right, And if you wish to, share any of the images in this presentation you can always get back to me at my email address,

thank you.