A warm welcome to all the students. I'm Mr. Narayan Bandodkar, Assistant professor, Govt. College of Arts, Science and Commerce, Quepem-Goa. I will be discussing module: Unijunction Transistor (UJT) from unit2: Industrial devices. In this module we are going to discuss the concept of unijunction transistor, its construction and working principle and static emitter characteristics of UJT. After learning this module, the learner will be able to get introduced to unijunction transistor, will be able to understand the construction and working principle of unijunction transistor and will be able to understand the static emitter characteristics of unijunction transistor. Let us now try to understand unijunction transistor (UJT). It is a semiconductor switching device consisting of a pn junction and having three terminals emitter, base1 and base2. If we consider the structure of UJT, it basically consists of a lightly doped n-type silicon bar, being lightly doped it is highly resistive. Two metal contacts are formed to this silicon bar on either side. On the upper side a metal contact is formed and it represents base terminal2 or base2. On the lower side another metal contact is formed and it represents base terminal1 or base1. In this lightly doped n-type silicon bar a heavily doped p-type semiconducting material is added closer to base terminal2 and thus forming a pn junction. A metal contact is formed for this p-type semiconducting material and it represents emitter. So, there are 3 terminals for UJT: emitter, base2 and base1. The symbol shows the three terminals of UJT as emitter, base2 and base1 with emitter terminal shown closer to base terminal2 and there is a slight bend here and this arrow indicate the direction of emitter current. Let us now try to understand the electrical equivalent diagram for UJT. Now, this lightly doped n-type silicon bar is highly resistive and we can divide this entire resistance into two parts as R_{B2} and R_{B1}. From this point to base2 it is R_{B2}. From this point to base1 it is R_{B1} and R_{B1} is greater than R_{B2}. Now, since there is a formation of pn junction in UJT, so this pn junction is represented by a diode symbol as shown here. So this is an electrical equivalent diagram which can be shown or drawn for UJT. Let us now try to understand the working principle of UJT with the help of equivalent diagram. When voltages are not applied to emitter, base2 and base1, the UJT offers resistance between its base terminals and this resistance is called interbase resistance and it is represented by R_{BB}. Mathematically R_{BB} can be written as $(R_{B1}+R_{B2})$ where R_{B1} is greater than R_{B2}. Now when V_{BB} is set to zero volt and emitter voltage is applied and it is varied let us see what happens to UJT. So under this condition when V_{BB} is zero volt, there is no current flowing through this resistor R_{B2}. As we vary the value of V_E this pn junction will be forward biased and our UJT is going to behave like a diode and it is going to exhibit characteristics similar to a forward biased diode. If we look at the characteristics that is static emitter characteristics it shows that when V_{BB} is zero volt than UJT gives characteristics similar to a forward biased pn junction diode as you can see in this diagram. Let us now try to understand what happens when some value of V_{BB} is applied between the base terminals. So, these resistances R_{B1} and R_{B2} along with V_{BB} forms a potential divider or voltage divider. So, as a result there will be voltage drop across R_{B1} and R_{B2}. So, let us now try to find out how much is the voltage drop across R_{B1}. So, using potential divider formula, the voltage across R_{B1} is given by V_1 is equal to R_{B1} upon $(R_{B1}+R_{B2})$ of V_{BB}. But we know that $(R_{B1}+R_{B2})$ is nothing but interbase resistance and I can write it as R_{BB}. So this ratio of resistances R_{B1} to R_{BB} is called intrinsic stand-off ratio and it is represented by η. The value of this intrinsic stand-off ratio lies between 0.5 to 0.85 for different UJT's. So if I substitute for η in this equation than V_1 can be written as ηV_{BB}. So, ηV_{BB} is called intrinsic stand-off voltage and it is the voltage which drops across R_{B1}. So when emitter voltage V_E is set to zero volt and when voltage drops across R_{B1}, let us see what happens to this diode. So, this voltage on n-side is high and on p-side voltage is zero volt which is low, so this pn junction inside the UJT remain reverse biased and we say that UJT is off. UJT operates in the cut-off region, only current that can flow under this condition is the leakage current due to minority charge carriers so that you can see it in this diagram. So, UJT operates in the cut-off region and only the leakage current flows due to minority charge carriers. When some voltage V_{BB} is applied here and when initially voltage V_E is set to zero, now let us see what happens as I increase the value of V_E. As the value of emitter voltage V_E is increased and when it overcomes ηV_{BB} that is the voltage across R_{B1} and forward voltage drop of diode which is V_D, the device turns on, pn junction turns on. We say that UJT turns on and this emitter voltage at which UJT turns on is called peak point voltage. Mathematically peak point voltage is given by ηV_{BB} plus diode voltage. If we look at the characteristics here, as the emitter voltage is increased and when it overcomes ηV_{BB} and diode voltage, this pn junction turns on and as a result emitter current starts flowing through R_{B1} and resistance of R_{B1} decreases thereby injecting more charge carriers in R_{B1} and the resistance of R_{B1} decreases and conductivity of R_{B_1} increases. So, let us see what happens at peak point voltage. As we increase the emitter voltage, when it reaches to peak point voltage, any attempt to increase the emitter voltage beyond peak point it drops a lower value of voltage called valley point voltage. So between peak point voltage to valley point voltage our UJT offers negative resistance and this region of operation of UJT is called negative resistance region and after valley point voltage the device operates in the saturation region where emitter voltage remains almost constant at valley point voltage but emitter current goes on increasing. So, this is what is happening when V_{BB} is given some high voltage. Let us see now what happens when VBB voltage is increased. Here it was 5V, now I am increasing it to 10V. So, as per this equation for peak point voltage which is given by ηV_{BB} plus diode voltage. The diode voltage is fixed so only changing quantity is V_{BB} here. So, if I increase the value of V_{BB} than peak point voltage is also increasing. So, from the characteristics it is clear that we get higher value of peak point voltage and then it drops to valley point voltage. The characteristic is similar in nature obtained for V_{BB} = 10V and after valley point voltage the device operates in the saturation region. So, this is how we can understand the working of UJT with the help of its equivalent diagram and we can also understand the static emitter characteristics of our UJT. These are my references. Thank you.
