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Chapter 1 : Harsany, Introduction to Electronics: DC/AC Circuits | Pearson

Online electric circuits simulator for STEM and technology education, Simulate and troubleshoot broken circuits in a rich simulation environment, easy to learn.

Beginning operation in December at West Twenty-Fifth Street, the high voltages it operated at allowed it to power a 2-mile 3. The late s and early s saw electricity starting to be generated at power stations. These were initially set up to power arc lighting a popular type of street lighting running on very high voltage usually higher than volt direct current or alternating current. Because of the significant advantages of alternating current over direct current in using transformers to raise and lower voltages to allow much longer transmission distances, direct current was replaced over the next few decades by alternating current in power delivery. In the mids, high-voltage direct current transmission was developed, and is now an option instead of long-distance high voltage alternating current systems. For long distance underseas cables e. For applications requiring direct current, such as third rail power systems, alternating current is distributed to a substation, which utilizes a rectifier to convert the power to direct current. Various definitions[edit] Types of direct current The term DC is used to refer to power systems that use only one polarity of voltage or current, and to refer to the constant, zero-frequency, or slowly varying local mean value of a voltage or current. The DC solution of an electric circuit is the solution where all voltages and currents are constant. It can be shown that any stationary voltage or current waveform can be decomposed into a sum of a DC component and a zero-mean time-varying component; the DC component is defined to be the expected value, or the average value of the voltage or current over all time. Although DC stands for "direct current", DC often refers to "constant polarity". Under this definition, DC voltages can vary in time, as seen in the raw output of a rectifier or the fluctuating voice signal on a telephone line. Some forms of DC such as that produced by a voltage regulator have almost no variations in voltage , but may still have variations in output power and current. Circuits[edit] A direct current circuit is an electrical circuit that consists of any combination of constant voltage sources, constant current sources, and resistors. In this case, the circuit voltages and currents are independent of time. A particular circuit voltage or current does not depend on the past value of any circuit voltage or current. This implies that the system of equations that represent a DC circuit do not involve integrals or derivatives with respect to time. If a capacitor or inductor is added to a DC circuit, the resulting circuit is not, strictly speaking, a DC circuit. However, most such circuits have a DC solution. This solution gives the circuit voltages and currents when the circuit is in DC steady state. Such a circuit is represented by a system of differential equations. The solution to these equations usually contain a time varying or transient part as well as constant or steady state part. It is this steady state part that is the DC solution. There are some circuits that do not have a DC solution. Two simple examples are a constant current source connected to a capacitor and a constant voltage source connected to an inductor. In electronics, it is common to refer to a circuit that is powered by a DC voltage source such as a battery or the output of a DC power supply as a DC circuit even though what is meant is that the circuit is DC powered.

Chapter 2 : Electrical DC Series and Parallel Circuit

Direct current (also known as DC) is the flow of charged particles in one unchanging direction (most commonly found as electron flow through conductive materials). DC can be found in just about every home and electronic device, as it is more practical (compared to AC from power stations) for many consumer devices.

The components may be active or inactive or both. This is a very basic definition of electrical circuit. DC Circuit There are two types of electricity - direct current and alternating current , i. The circuit that deals with direct current or DC, is referred as DC circuit and the circuit that deals with alternating current or AC, is generally referred as AC Circuit. The components of the electrical DC circuit are mainly resistive, where as components of the AC circuit may be reactive as well as resistive. Any electrical circuit can be categorized into three different groups - series, parallel and series parallel. So for example, in the case of DC, the circuits can also be divided into three groups, such as series DC circuit, parallel DC circuit and series and parallel circuit. Series DC Circuit When all the resistive components of a DC circuit are connected end to end to form a single path for flowing current , then the circuit is referred as series DC circuit. The manner of connecting components end to end is known as series connection. Suppose we have n number of resistors R1, R2, R Rn and they are connected in end to end manner, means they are series connected. If this series combination is connected across a voltage source , the current starts flowing through that single path. As the resistors are connected in end to end manner, the current first enters in to R1, then this same current comes in R2, then R3 and at last it reaches Rn from which the current enters into the negative terminals of the voltage source. In this way, the same current circulates through every resistor connected in series. Hence, it can be concluded that in a series DC circuit, the same current flows through all parts of the electrical circuit. If the resistances of the resistors are not equal then the voltage drop across them would also not be equal. Thus, every resistor has its individual voltage drop in a series DC circuit. This is just a conceptual representation. Let current I quantified as Ampere flow through the series circuit. Therefore, So, effective resistance of the series DC circuit is. From the above expression it can be concluded, that when a number of resistors are connected in series, the equivalent resistance of the series combination is the arithmetic sum of their individual resistances. From the above discussion, the following points come out: When a number of electrical components are connected in series, the same current flows through all the components of the circuit. The applied voltage across a series circuit is equal to the sum total of voltage drops across each component. The voltage drop across individual components is directly proportional to its resistance value. Parallel DC Circuit When two or more electrical components are connected in a way that one end of each component is connected to a common point and the other end is connected to another common point, then the electrical components are said to be connected in parallel, and such an electrical DC circuit is referred as a parallel DC circuit. In this circuit every component will have the same voltage drop across them, and it will be exactly equal to the voltage which occurs between the two common points where the components are connected. Also in a parallel DC circuit, the current has several parallel paths through these parallel connected components, so the circuit current will be divided into as many paths as the number of components. Here, in this electrical circuit, the voltage drop across each component is equal. As the voltage drop across every component connected in parallel is the same, the current through them is inversely proportional to its resistance value. R3 Thus when a number of resistors are connected in parallel, the reciprocal of the equivalent resistance is given by the arithmetic sum of the reciprocals of their individual resistances. From the above discussion of parallel DC circuit, we can come to the following conclusion: Voltage drops are the same across all the components connected in parallel. Current through individual components connected in parallel, is inversely proportional to their resistances. Total circuit current is the arithmetic sum of the currents passing through individual components connected in parallel. The reciprocal of equivalent resistance is equal to the sum of the reciprocals of the resistances of individual components connected in parallel. Series and Parallel Circuit So far we have discussed series DC circuit and parallel DC circuit separately, but in practice, the electrical circuit is generally a combination of both series circuits and parallel circuits. Series and Parallel Circuit.

Chapter 3 : AC/DC Electrical Training System | Basic Electrical Troubleshooting | Amatrol

The first in Delmar Learning's Herrick & Jacob Series, six tightly integrated electronics engineering technology texts, DC/AC Circuits and Electronics: Principles & Applications teaches readers how to apply basic laws and analysis techniques to traditional introductory circuits, as well as popular.

High voltage transmission lines deliver power from electric generation plants over long distances using alternating current. These lines are located in eastern Utah. High voltages have disadvantages, such as the increased insulation required, and generally increased difficulty in their safe handling. In a power plant , energy is generated at a convenient voltage for the design of a generator , and then stepped up to a high voltage for transmission. Near the loads, the transmission voltage is stepped down to the voltages used by equipment. Consumer voltages vary somewhat depending on the country and size of load, but generally motors and lighting are built to use up to a few hundred volts between phases. The voltage delivered to equipment such as lighting and motor loads is standardized, with an allowable range of voltage over which equipment is expected to operate. Standard power utilization voltages and percentage tolerance vary in the different mains power systems found in the world. High-voltage direct-current HVDC electric power transmission systems have become more viable as technology has provided efficient means of changing the voltage of DC power. Transmission with high voltage direct current was not feasible in the early days of electric power transmission , as there was then no economically viable way to step down the voltage of DC for end user applications such as lighting incandescent bulbs. Three-phase electrical generation is very common. In practice, higher "pole orders" are commonly used. The advantage is that lower rotational speeds can be used to generate the same frequency. If the load on a three-phase system is balanced equally among the phases, no current flows through the neutral point. Even in the worst-case unbalanced linear load, the neutral current will not exceed the highest of the phase currents. Harmonics can cause neutral conductor current levels to exceed that of one or all phase conductors. For three-phase at utilization voltages a four-wire system is often used. When stepping down three-phase, a transformer with a Delta 3-wire primary and a Star 4-wire, center-earthed secondary is often used so there is no need for a neutral on the supply side. For smaller customers just how small varies by country and age of the installation only a single phase and neutral, or two phases and neutral, are taken to the property. For larger installations all three phases and neutral are taken to the main distribution panel. From the three-phase main panel, both single and three-phase circuits may lead off. Three-wire single-phase systems, with a single center-tapped transformer giving two live conductors, is a common distribution scheme for residential and small commercial buildings in North America. This arrangement is sometimes incorrectly referred to as "two phase". A similar method is used for a different reason on construction sites in the UK. A third wire , called the bond or earth wire, is often connected between non-current-carrying metal enclosures and earth ground. This conductor provides protection from electric shock due to accidental contact of circuit conductors with the metal chassis of portable appliances and tools. Bonding all non-current-carrying metal parts into one complete system ensures there is always a low electrical impedance path to ground sufficient to carry any fault current for as long as it takes for the system to clear the fault. This low impedance path allows the maximum amount of fault current, causing the overcurrent protection device breakers, fuses to trip or burn out as quickly as possible, bringing the electrical system to a safe state. AC power supply frequencies[edit] Further information: A low frequency eases the design of electric motors, particularly for hoisting, crushing and rolling applications, and commutator-type traction motors for applications such as railways. However, low frequency also causes noticeable flicker in arc lamps and incandescent light bulbs. The use of lower frequencies also provided the advantage of lower impedance losses, which are proportional to frequency. Effects at high frequencies[edit] Play media A Tesla coil producing high-frequency current that is harmless to humans, but lights a fluorescent lamp when brought near it A direct current flows uniformly throughout the cross-section of a uniform wire. This is because the acceleration of an electric charge in an alternating current produces waves of electromagnetic radiation that cancel the propagation of electricity toward the center of materials with high conductivity. This phenomenon is called skin effect. At very high frequencies the current no longer flows in the wire, but effectively flows on the surface of the wire, within a thickness of a few skin depths. For example, the skin depth of a copper conductor is approximately 8. Since the current tends to flow in the periphery of conductors, the effective cross-section of the conductor is reduced. This increases the effective AC resistance of the conductor, since resistance is inversely proportional to the cross-sectional area. The AC resistance often is many times higher than the DC resistance, causing a much higher energy loss due to ohmic heating also called I2R loss. Techniques for reducing AC resistance[edit] For low to medium frequencies, conductors can be divided into stranded wires, each insulated from one another, and the relative positions of individual strands specially arranged within the conductor bundle. Wire constructed using this technique is called Litz wire. This measure helps to partially mitigate skin effect by forcing more equal current throughout the total cross section of the stranded conductors. Litz wire is used for making high-Q inductors , reducing losses in flexible conductors carrying very high currents at lower frequencies, and in the windings of devices carrying higher radio frequency current up to hundreds of kilohertz , such as switch-mode power supplies and radio frequency transformers. Techniques for reducing radiation loss[edit] As written above, an alternating current is made of electric charge under periodic acceleration , which causes radiation of electromagnetic waves. Energy that is radiated is lost. Depending on the frequency, different techniques are used to minimize the loss due to radiation. This reduces losses from electromagnetic radiation and inductive coupling. A twisted pair must be used with a balanced signalling system, so that the two wires carry equal but opposite currents. Each wire in a twisted pair radiates a signal, but it is effectively cancelled by radiation from the other wire, resulting in almost no radiation loss. Coaxial cables[edit] Coaxial cables are commonly used at audio frequencies and above for convenience. A coaxial cable has a conductive wire inside a conductive tube, separated by a dielectric layer. The current flowing on the surface of the inner conductor is equal and opposite to the current flowing on the inner surface of the outer tube. The electromagnetic field is thus completely contained within the tube, and ideally no energy is lost to radiation or coupling outside the tube. Coaxial cables with an air rather than solid dielectric are preferred as they transmit power with lower loss. Waveguides[edit] Waveguides are similar to coaxial cables, as both consist of tubes, with the biggest difference being that the waveguide has no inner conductor. Waveguides can have any arbitrary cross section, but rectangular cross sections are the most common. Because waveguides do not have an inner conductor to carry a return current, waveguides cannot deliver energy by means of an electric current , but rather by means of a guided electromagnetic field. Although surface currents do flow on the inner walls of the waveguides, those surface currents do not carry power. Power is carried by the guided electromagnetic fields. The surface currents are set up by the guided electromagnetic fields and have the effect of keeping the fields inside the waveguide and preventing leakage of the fields to the space outside the waveguide. Waveguides have dimensions comparable to the wavelength of the alternating current to be transmitted, so they are only feasible at microwave frequencies. In addition to this mechanical feasibility, electrical resistance of the non-ideal metals forming the walls of the waveguide cause dissipation of power surface currents flowing on lossy conductors dissipate power. At higher frequencies, the power lost to this dissipation becomes unacceptably large. Instead, fiber optics , which are a form of dielectric waveguides, can be used. For such frequencies, the concepts of voltages and currents are no longer used. Mathematics of AC voltages[edit] A sinusoidal alternating voltage.

Chapter 4 : AC-DC Power Converters | Electronics Tutorial

Both AC and DC describe types of current flow in a circuit. In direct current (DC), the electric charge (current) only flows in one direction. Electric charge in alternating current (AC), on the other hand, changes direction periodically.

Alternating Current AC vs. Direct Current DC July 26, by Editorial Electric current is the amount of electric charges that passes through a wire with respect to time. When battery is connected across a conductor , electrons move from negative terminal to positive terminal of battery. They move with very high velocity more than the speed of light and thus produce some amount of heat energy. Due to this, light bulbs glow. Electric current is categorized into two types: The difference is that direct current flows in one direction while alternating current changes its direction rapidly. Both AC and DC have their own specific uses but AC is the more common type of current that we use today at home, offices, etc. They battled over the standardization of the current notation. After all AC won the battle when it powered France Fair and finally, it came into existence. Alternating Current AC An electric current is current that reverses its direction many times a second at regular intervals. It is typically used in power supplies. A number of times the current changes its direction in one second can be defined as the frequency of AC. Frequency in the USA is 60Hz. AC is generated by devices called alternators. An alternator is a machine that converts mechanical energy into alternating current. Here mechanical sources of mechanical energy include steam turbines, internal combustion engines, and water turbines. Today generator provides nearly all of the power for electric power grids. AC waveform AC can be represented by many waveforms like a triangular wave, square wave but the most common representative is a sine wave. It is represented by amplitude and time. Amplitude is the peak value of the current. AC is widely used in industries of transportation and production of electricity. Almost every house is powered by AC. AC is also used to power electric motors. DC is not used to power houses due to high risk of cost, and converting voltages. AC is easy to generate than DC. The loss of energy during transmission is negligible. AC can be easily converted to DC. It is easy to transmit. In AC, resistance is greater than DC. At high voltage it is dangerous to work with AC as the shock of AC is attractive but the shock of DC is repulsive in nature. AC is not efficient and needs power factor management for efficiency. Most of the gadgets do not run directly on AC. Direct current DC Direct current refers to electric charges flowing in one direction. This type of current is most commonly produced by batteries. DC waveform DC circuits have a unidirectional flow of current and like AC it is not changing the direction periodically. Waveform of DC is a pure sine wave. As you can see, the voltage is constant with respect to time. DC power is widespread in low voltage applications such as charging batteries, automotive applications, and aircraft applications and in almost all electronic gadgets like mobile phone, music players, etc. Conversion of AC into DC: We get DC from the following things: Batteries, in which chemical reactions happen and then this chemical energy is converted into electrical energy. AC to DC conversion via a rectifier. Rectifier is an electronic circuit which converts AC into DC. These rectifiers can be seen in our mobile chargers, battery eliminators, etc. AC and DC sources: Alternating current and Direct current source can be denoted by these symbols. AC and DC voltage source symbols The direction of current changes at a regular interval of time in AC source while in DC source change in direction is constant. You can see the difference in the figure below: Direction of Current It is able to power most electronic gadgets. It is easy to store DC. It is costlier to produce. It is difficult to transport. It is difficult to generate DC as compared to AC. Direct Current DC Thomas Edison proposed a network of power plants which produced DC power and they could power houses nearer to 1 mile from that power plant. DC is very difficult to transport from one place to another. So Tesla came up with AC power but Edison considered this type of current as extremely dangerous. AC can be easily transported from one place to another using a transformer. This can power to houses many miles away from power houses and thus can reach to more number of people. AC finally came into existence when it powered France Fair successfully. AC changes its direction in regular interval of time while DC is unidirectional flow. Due to many advantages of AC, it used to power our houses and offices while DC is used to power low power devices. AC is easier to transform between voltage levels, which makes high-voltage transmission more feasible. DC, on the other hand, is found in almost all electronics. Both have their own uses, advantages, and disadvantages. AC is more widely used to power buildings and offices while DC is more widely used to power electronic gadgets. Our lifestyle is dependent on both of them.

Chapter 5 : DC Electronics | Learn Electronics Online

Rectifier is an electronic circuit which converts AC into DC. These rectifiers can be seen in our mobile chargers, battery eliminators, etc. Most of the gadgets are powered or charged indirectly by AC and then this AC is converted to DC.

By using two 2N transistors we become more then 2 times the amount of amps then the power supply delivers, making it real though to brake ;. Although you could use this design to deliver 20 amps with almost no modifications and with a proper transformer and a huge heat sink with a fan , I did not needed such much power. Make sure you mount them on a huge heat sink, as the 2N transistors can get very hot at full load. Volt Output adj by VRK. IC LM to hold heat-sink. Transformer is 20A up. Well this circuit should do the trick for you. It will supply 15 watts of AC power to a device. It should power lamps, shavers, small stereos and small appliances. If you draw to much power the circuit will shut down all by itself. The wattage depends on which transistors you use for Q1 and Q2, as well as the "Amp Rating" of the transformer you use for T1. This inverter can be constructed to supply anywhere from 1 to 1 KW watts.. This inverter can be constructed to supply anywhere from 1 to 1 KW watts Well, this inverter should solve that problem. The wattage depends on which tansistors you use for Q1 and Q2, as well as how "big" a transformer you use for T1. The inverter can be constructed to supply anywhere from 1 to 1 KW watts Your local electronics shop or model railway supply will have these ma DC-to-AC Converter - This circuit was used to provide battery backup to a device that had an AC output wall transformer. Designed by Andrew R. For example, you could run 12V car accessories in a 6V British? By changing just a few components, you can also modify it for different voltages. The note also includes two "Royer" based designs for low voltage systems. How Many Bits Is Enough? It can insure regulation during low line voltage conditions or it can squeeze a few more watts out of a plug-in-the-wall power adapter power supply. Switched-capacitor circuit doubles, inverts dc source This design suits low-end ac applications or high-precision level-setting applications that rely on a single-ended current-output DAC Hex-inverter-based design suits frequencies up to MHz The only hard-to-find piece of this baby is the so-called yellow inverter transformer. The inverter can be constructed to supply anywhere from 1 to 1 KW watts. It draws power from the vac power line but it uses a small 6KV camera flash trigger coil. The output signal is isolated from the power line. Although the circuit can only deliver about 5uA of current it can produce dangerous shocks, so be careful. It uses two tiny SCRs that alternately discharge two capacitors through a miniature high frequency transformer. The voltage spikes produced through the transformer are rectified, filtered and regulated. A very common 8 ohm audio impedance matching transformer can be used for the transformer. Published in EDN, Feb. Efficient and Practical Design If you want to swap charge in either direction between unevenly loaded positive and negative battery buses, you need an inverting dc transformer. One implementation is the symmetrical flyback converter shown in Figure 1. The circuit can generate a negative output

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Chapter 6 : Alternating Current (AC) vs. Direct Current (DC) - Codrey Electronics

A power inverter, or inverter, is an electronic device or circuitry that changes direct currentÃ, (DC) to alternating current (AC). A power inverter can be entirely electronic or may be a combination of mechanical effects (such as a rotary apparatus) and electronic circuitry.

College Audience Table Of Content 1. Units and Number Notation Lecture 1 1. Units of Measurement 1. Powers of 10 1. Powers of 10 Algebra 1. Scientific and Engineering Notation 1. Unit Consistency and Conversions 1. Order of mathematical Operations 2. Current, Voltage and Common Lecture 2 2. Atomic Structure and Charge 2. Conductor, Insulator, Semiconductor 2. Current Meter Connection 2. Voltmeter Connection Lecture 3 2. Voltage Notation Applied to Circuits 3. Resistance Lecture 4 3. Short and Open Circuits Lecture 5 3. Ideal Diode Ideal diode Practical diode? Resistance Applications Lecture 6 4. Fuses and Circuit Breakers 4. Potentiometers and Rheostats 4. Sensors Utilizing Resistance 5. KCL and the Simple Node 5. KCL Alternate Form 6. Node Voltages and Voltage Drops Lecture 10 6. KVL Alternate Form 7. BJT Circuit Application 7. Op Amp Circuit Application 7. Series Circuits Lecture 14 8. Series Circuits and the Laws Computer Simulations 8. Resistive Series Circuit Analysis Lecture 15 8. Resistance of a Series Circuit 8. Current Meter Loading Lecture 16 8. Essentially Series Lecture 18 9. Ideal Operational Amplifier 9. Comparator Op Amp Lecture 19 9. Comparator with Positive Feedback Lecture 20 9. Parallel Circuits Lecture 21 Conductance and Resistance of a Parallel Circuit Lecture 22 Current Divider Rule Parallel Current Sources Lecture 23 Series-Parallel Circuits Lecture 24 Series-Parallel Circuit Combinations Resistance Reduction Techniques Bridge Circuit Str Reviews This textbook introduces the basic circuit laws and analysis techniques, and applies them to electronic devices.

Chapter 7 : DC to AC Circuits - Electronic Hobby Projects & Circuits

DC Electronics The lessons in this area will focus on the basics of Direct Current (DC) circuits and applications. We will start at the beginning with some light electronics theory, then to basic circuit concepts, covering the fundamental parts of a circuit, and looking at power supplies, wiring, switches, and resistors.

Chapter 8 : DC/AC Circuits and Electronics: Principles & Applications - Robert J. Herrick - Google Books

In the next tutorial about DC Circuits we will look at Ohms Law which is a mathematical equation explaining the relationship between Voltage, Current, and Resistance within electrical circuits and is the foundation of electronics and electrical engineering.

Chapter 9 : DC/AC Circuits and Electronics

Many electronics circuits work with AC components to them, but they have a DC offset to them to prevent the polarity switching. It would be something like 5VppAc with a offset DC offset would be an Ac signal from V.