**Series Circuit**

**5.2 SERIES CIRCUITS**

Two elements are in series if:

1. They have only one terminal in common
2. The common point between them is not connected to another current carrying element.

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| In the circuit *E*, *R1* and *R2* are in series.  All elements in the circuit are in series: Series Circuit  The current is the same through series elements.  A branch of a circuit is any portion of the circuit having one or more elements in series. |  |

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| *R1* and *R2* are not in series because at point (b) the common between them is connected to *R3* which carries a current |  |

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| ***The total resistance of a series circuit is the sum of the resistance levels.***    If *R1*= *R2*= *R3*= …..= *RN* = *R* |  |

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| Once *RT* is known the circuit can be replaced by the one shown: and then    E is fixed: *Is* depends on *RT*.  , ….  , ……    ***The total power delivered to a resistive circuit is equal to the total power dissipated by the resistive elements.*** |  |

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**5.3 VOLTAGE SOURCES IN SERIES**

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| Voltage sources can be connected in series to increase or decrease the total voltage applied:  The net voltage is determined simply by summing the sources with the same polarity and subtracting the total of the sources with the opposite polarity.  Net polarity ≡ polarity of the larger sum. |  |

**5.4 KIRCHHOFF’S VOLTAGE LAW**

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| **Kirchhoff’s voltage law *(KVL) states that the algebraic sum of the potential rises and drops around a closed loop (or path) is zero.***  A **closed loop** is any continuous path that leaves a point in one direction and returns to that same point from another direction without leaving the circuit.      The applied voltage of a series circuit equals the sum of the voltage drops across the series elements: | abcda ≡ closed loop |

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| ***The application of Kirchhoff’s voltage law need not follow a path that includes current-carrying elements.*** |  |

**!!!!! Polarity is very important when applying KVL !!!!!**

**EXAMPLE 5.4** Determine the unknown voltages for the networks of the Figures.

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| Application of Kirchhoff’s voltage law in clockwise direction results in: |  |
| or |  |

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**5.5 INTERCHANGING SERIES ELEMENTS**

The elements of a series circuit can be interchanged without affecting the total resistance, current, or power to each element.

**5.6 VOLTAGE DIVIDER RULE**

***In a series circuit: the voltage across the resistive elements will divide as the magnitude of the resistance levels.***

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| --- | --- | --- |
| *R1* = 2*R2* *V1* = 2*V2*  *R2* = 3*R3* *V2* = 3*V3*  The current *I* change by the values of *R*’s, but the voltage remain the same. |  |  |

|  |  |
| --- | --- |
| *R1* = 1000 *R2* *V1* = 1000 *V2*  *R1* = 10000*R3* *V1* = 10000*V3* |  |

|  |  |
| --- | --- |
| *RT* = *R1* + *R2*      In General:  (Voltage Divider Rule) |  |

***The voltage across a resistor in a series circuit is equal to the value of that resistor times the total impressed voltage across the series elements divided by the total resistance of the series elements.***

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**5.7 NOTATION**

**Voltage Sources and Ground:**

 

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**Double-Subscript Notation**

Voltage is always **across** (between) two points resulted in a double –subscript notation that defines the first subscript as the higher potential



***The double-subscript notation Vab specifies point “a” as the higher potential. If this is not the case, a negative sign must be associated with the magnitude of Vab.***

***The voltage Vab is the voltage at point “a” with respect to (w.r.t.) point “b”.***

**Single-Subscript Notation:**

If one of the point is specified as ground (reference) then a single subscript is employed, that provide the voltage with respect to ground.

***If the voltage is less than zero volts, a negative sign must be associated with the magnitude of Va .***

|  |  |
| --- | --- |
| In general: |  |