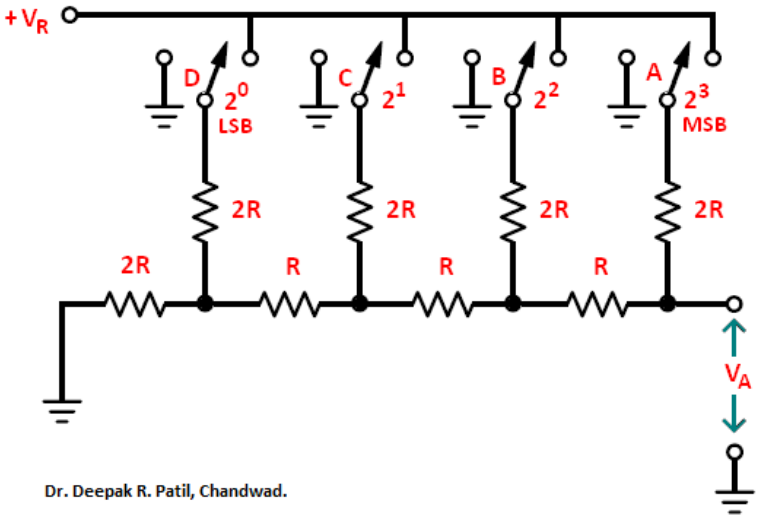
**Title:** DAC using R-2R Ladder Network.

**Aim:** To build and study DAC using R-2R ladder network.

**Components:** Resisters, LEDs.

**Equipment's and Miscellaneous:** Regulated DC P.S. (0-25V), DMM, Breadboard, Connecting wires etc.

**Circuit Diagram:**




***Note: 1.*** *Use 2R = 10kΩ or any value and R = 5kΩ can be obtained by connecting two 2R resistors in parallel.*

***2.*** *Connect series combination of 220Ω resistor and LED between input and ground to see input.*

**Observation Table:** Logic 1 = $+V_R$ = …… and Logic 0 = ……..

| Obs. No. | Digital Input | | | | Equivalent Decimal Number | Analog Output Volts | | Error \|X-Y\| |
|---|---|---|---|---|---|---|---|---|
| | A ($2^3$) | B ($2^2$) | C ($2^1$) | D ($2^0$) | | Calculated (X) | Observed (Y) | |
| 1. | 0 | 0 | 0 | 0 | 0 | | | |
| 2. | 0 | 0 | 0 | 1 | 1 | | | |
| 3. | 0 | 0 | 1 | 0 | 2 | | | |
| 4. | 0 | 0 | 1 | 1 | 3 | | | |
| 5. | 0 | 1 | 0 | 0 | 4 | | | |
| 6. | 0 | 1 | 0 | 1 | 5 | | | |
| 7. | 0 | 1 | 1 | 0 | 6 | | | |
| 8. | 0 | 1 | 1 | 1 | 7 | | | |
| 9. | 1 | 0 | 0 | 0 | 8 | | | |
| 10. | 1 | 0 | 0 | 1 | 9 | | | |
| 11. | 1 | 0 | 1 | 0 | 10 | | | |
| 12. | 1 | 0 | 1 | 1 | 11 | | | |
| 13. | 1 | 1 | 0 | 0 | 12 | | | |
| 14. | 1 | 1 | 0 | 1 | 13 | | | |
| 15. | 1 | 1 | 1 | 0 | 14 | | | |
| 16. | 1 | 1 | 1 | 1 | 15 | | | |

**Calculations:**

Analog output voltage is given by

$$V_A = \frac{V_0 2^0 + V_1 2^1 + V_2 2^2 + \cdots + V_{n-1} 2^{n-1}}{2^n}$$

Where, n is Number of bits,

$V_0$, $V_1$, $V_2$, …….. $V_{n-1}$ are Digital input voltage levels corresponding to logic 1 and logic 0.

*(Leave enough space for calculations in practical book)*

**Result:** 1. Observed analog output voltage matches with calculated analog output voltage.

2. The graph of analog output voltage versus binary equivalent shows stepwise increase with step size equal to $\frac{V_R}{2^n}\ v$ i.e. analog output voltage corresponding to 0001.

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(Do not write on Practical Sheet)

**Precautions:**

1. Always connect ground first and then connect Vcc.
2. The kit should be off before changing the connections.
3. Switch off the kit after the experiment.

**Procedure:**

1. Calculate analog output voltage for various combinations from 0000 to 1111 of 4-bit R-2R ladder network.
2. Connect the circuit as shown in the diagram.
3. Connect voltages corresponding to logic 1 and logic 0 to the input bit position of R-2R ladder for various combinations from 0000 to 1111.
4. Read analog output voltage of R-2R ladder network for each combination using multimeter.
5. Compare calculated and observed values of analog output voltage corresponding to binary input combination and find the error value.
6. Plot a graph of analog output voltage versus binary number.