



ELEMENTS OF ELECTRICAL ENGINEERING

Course Code : UE25EE141A/B

FACULTY CONTRIBUTED:

Department of EEE, RR Campus

Prof . Jyothi T N

Prof. Vadhira^J K P P

Prof. Kruthika N

Prof. Suma S

Prof. Pushpa K R

Prof. Sangeeta Modi

Department of ECE, EC Campus

Prof. Lokesh L

Prof. Dhanashree G Bhate

Dr. Renuka R Kajur

Prof. Rajesh Chandrashekhar

Prof. Sangam Kumar G H

ELEMENTS OF ELECTRICAL ENGINEERING

Stepper Motor – Construction & Principle of Operation

Jyothi T.N

Department of Electrical & Electronics Engineering

Stepper Motor - Introduction

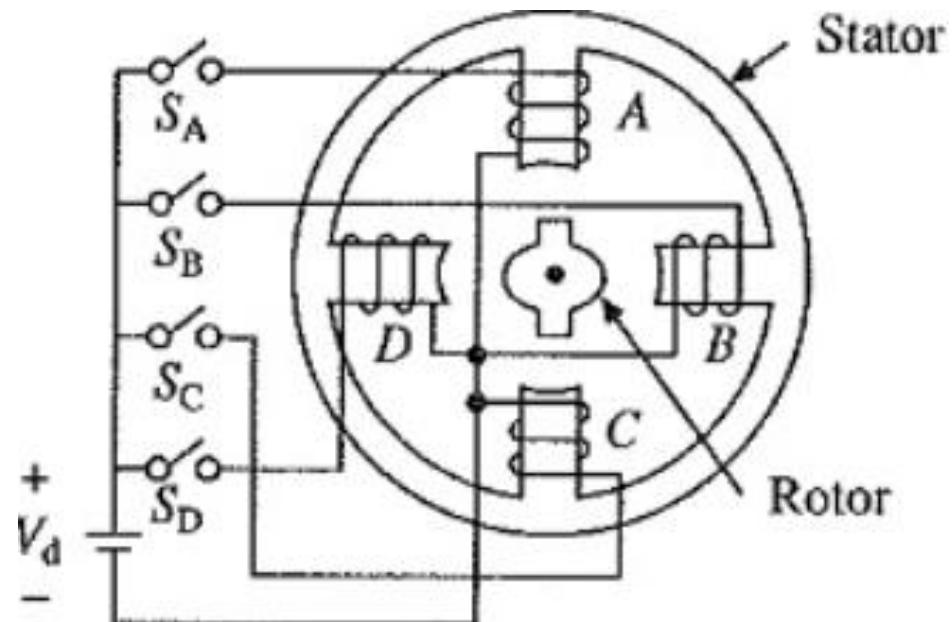
- Digital Electromechanical device which receives DC pulses and rotates in steps.
- Used for position and speed control applications.
- Because of simple control and compatibility with digital systems, used in a variety of applications such as printers, computer disk drives, Robotic arms, Electric watches etc.
- They come in three categories:
 - i) Variable Reluctance Stepper Motor
 - ii) Permanent Magnet Stepper Motor
 - iii) Hybrid Stepper Motor

Stator: Consists of Electromagnets excited by coils.

Rotor: A Salient pole type of structure with out any coils or permanent magnets.

Advantages: Low cost, High Torque to Inertia Ratio

Disadvantages: Higher Audible Noise, Relatively Low Torque



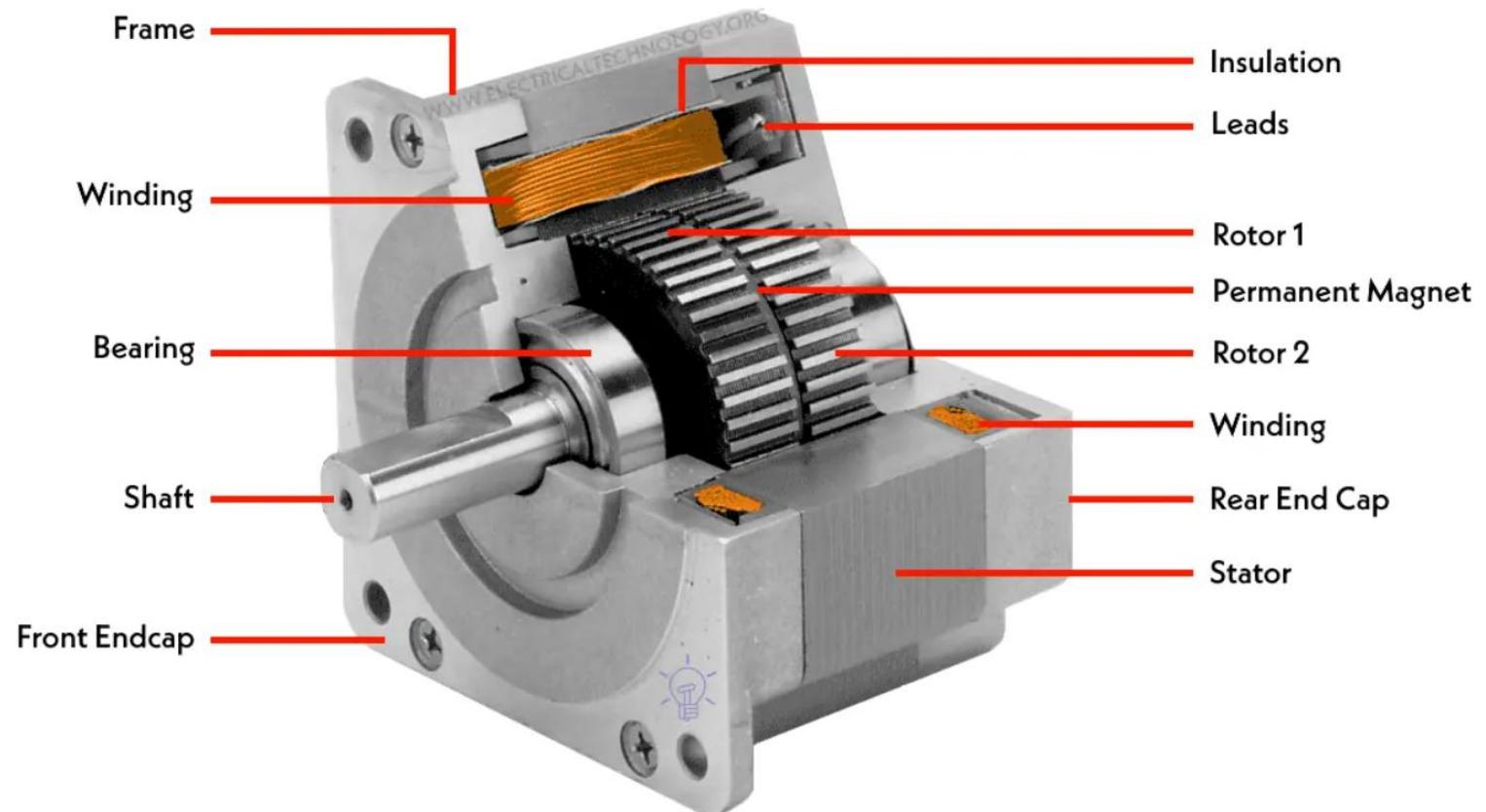
Stepper Motor – Permanent Magnet type

Stator: Consists of Electromagnets excited by coils.

Rotor: consists of radially magnetized permanent magnets.

Advantages: Higher Low speed torque, Quieter operation

Disadvantages: Higher cost due to Permanent Magnets.

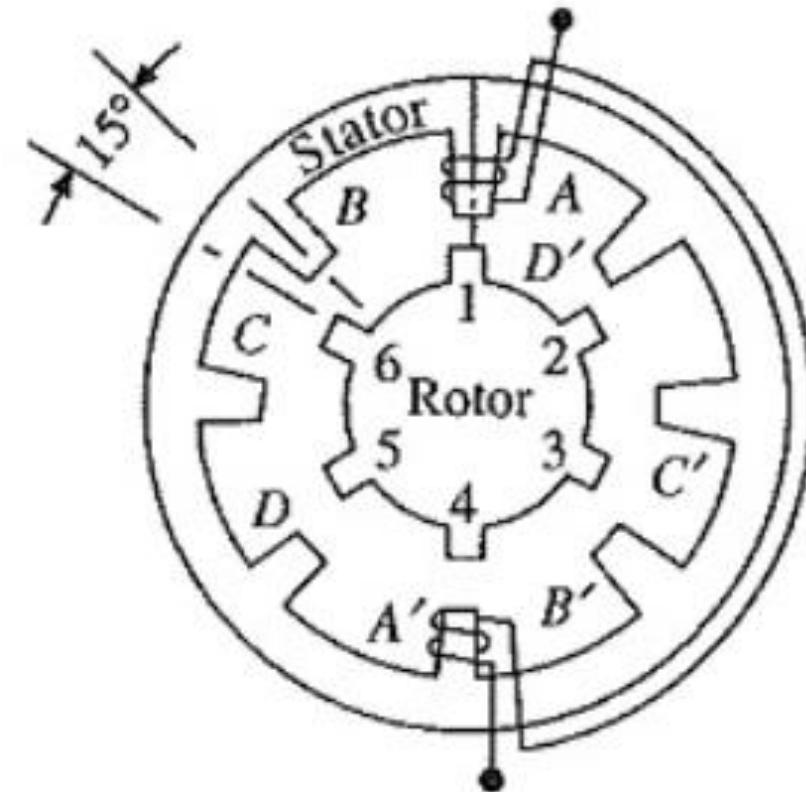


Stepper Motor – Principle of Operation

Let us consider 8/6 Variable reluctance stepper motor as shown:
[i.e., 8 electromagnets on stator & 6 salient poles on rotor]

When phase A is magnetized as shown, poles 1 & 4 are aligned with phase A poles as shown.

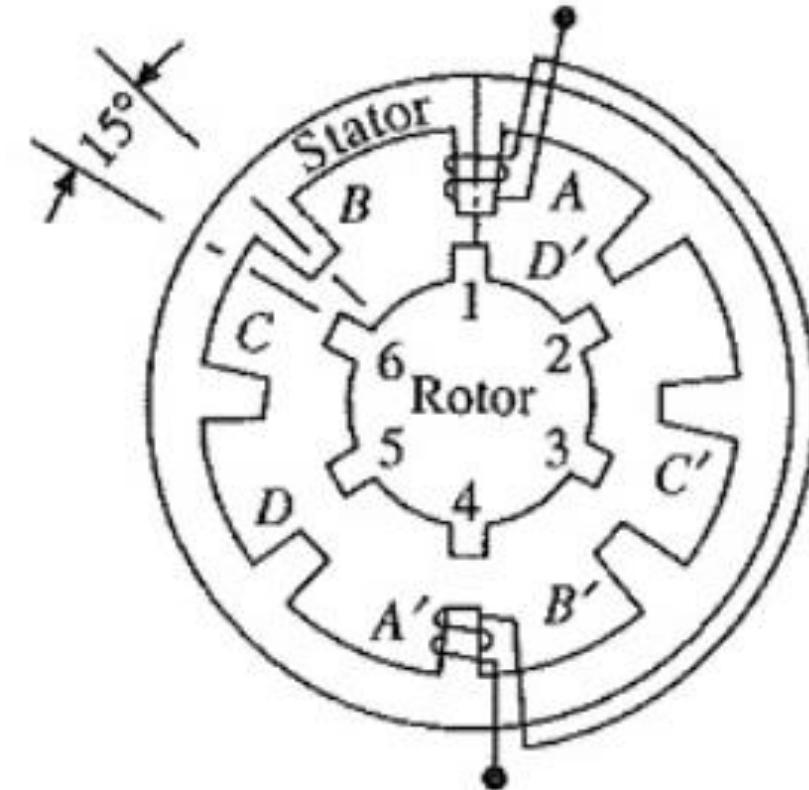
Next, phase A is turned OFF and phase B winding is turned ON which then attracts rotor poles 3 & 6 into alignment with phase B poles on stator.



Stepper Motor – Principle of Operation (contd..)

Next, phase B is turned OFF and phase C winding is turned ON which then attracts rotor poles 2 & 5 into alignment with phase C poles on stator.

Next, phase D is turned ON and phase C winding is turned OFF which then attracts rotor poles 1 & 4 into alignment with phase D poles on stator.

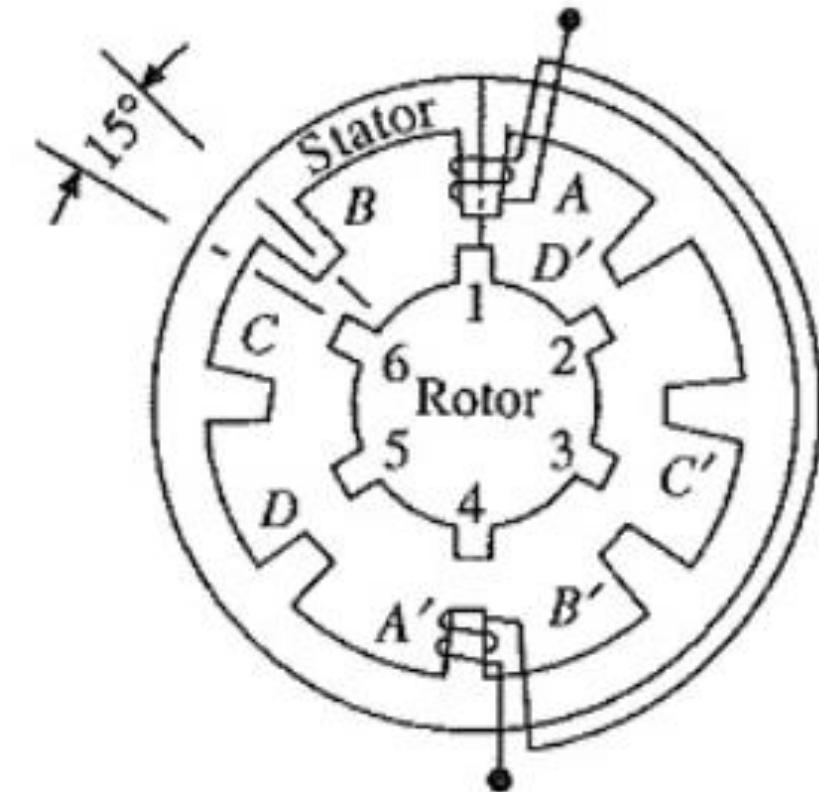


Stepper Motor – Principle of Operation (contd..)

Thus, phases are provided DC pulses in the sequence A , B , C , D , A , B , C , D so on, which leads to step wise rotation of the rotor clockwise in steps of 15° .

To rotate rotor stepwise anticlockwise, sequence must be A , D , C , B , A , D , C , B so on.

When only one phase is excited at a time, it is called Full Step Rotation where step angle would be 15°

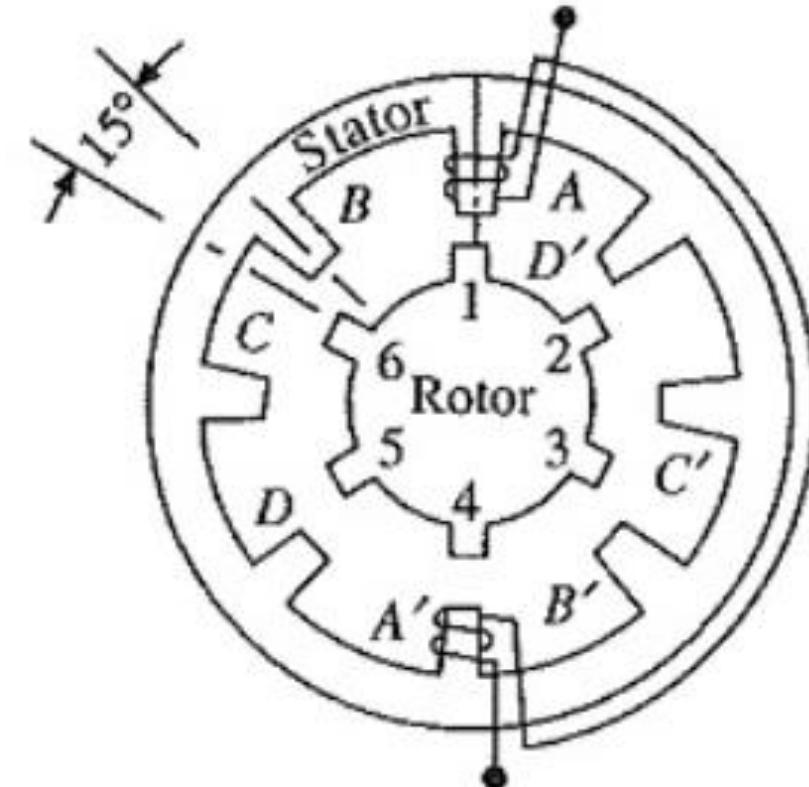


Stepper Motor – Principle of Operation (contd..)

By transitioning excitation from one phase to another phase with both phases excited in between, we can achieve micro stepping.

For instance, when excitation sequence such as A , A&B , B , B&C , C , C&D so on is followed, step size will be 7.5° . This is called Half Step rotation.

By different stator & rotor pole combinations, desired step angle can be achieved.



Text Book:

1. "Basic Electrical Engineering" S.K Bhattacharya, 1st Edition Pearson India Education Services Pvt. Ltd., 2017
2. "Basic Electrical Engineering", D. C. Kulshreshtha, 2nd Edition, McGraw-Hill. 2019
3. "Special Electrical Machines" E G Janardanan, PHI Learning Pvt. Ltd., 2014

Reference Books:

1. "Engineering Circuit Analysis" William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin, 10th Edition McGraw Hill, 2023
2. "Electrical and Electronic Technology" E. Hughes (Revised by J. Hiley, K. Brown & I.M Smith), 12th Edition, Pearson Education, 2016.
3. "Fundamentals of Electric Drives" , G K Dubey, 2nd Edition, Narosa Publishing House



PES
UNIVERSITY

THANK YOU

Jyothi T N

Department of Electrical & Electronics Engineering

jyothitn@pes.edu