Q

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Q3:- Types of Electric motors

→ DC motors
→ AC motors
→ other motors

Types of DC Motors

a) DC Shunt motor

It works on DC & the windings of this electric motor like the armature windings & field windings are linked in parallel known as shunt.

b) DC Series motor:

works on electromagnetic law, which states that whenever a magnetic field can be formed around conductor & interacts with an external field to generate the rotational motion.

c) PMDC motor:

This motor can be inbuilt with a permanent magnet to make the magnetic field necessary for electric motor operation.

Types of AC motors

a) Synchronous motor

It's working depends on 3-phase supply. The stator in the electric motor generates the field current which rotates in a stable speed based on AC frequency.

b) Induction motor

↳ It runs asynchronous speed. It mainly uses an electromagnetic induction for changing the energy from electric to mechanical.

Special purpose motors

a) Stepper motor :

It can be used to offer step angle revolution as an alternative to stable revolution.

b) Brushless DC motors:

It was diveloped for achieving superior performance within a lesser space than brushed DC motors.

c) Hysteresis motor:

The rotor of this motor can be induced hysterisis and eddy current to generate the required task.

Q6- Show that columns of Rotation matrix R_0^1 are orthogonal.

for matrix to be orthogonal $A \cdot A^T = I$

So, $R_0^1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$

$\therefore R_0^1 \cdot (R_0^1)^T = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix}$

$= \begin{bmatrix} 1+0+0 & 0+0+0 & 0+0+0 \\ 0+0+0 & 0+\cos^2\theta+\sin^2\theta & 0+\cos\theta\sin\theta-\cos\theta\sin\theta \\ 0+0+0 & 0+\sin\theta\cos\theta-\sin\theta\cos\theta & 0+\sin^2\theta+\cos^2\theta \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$

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Q7. Show that $\det(R_0^1) = 1$

$$|R_0^1| = \begin{vmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{vmatrix}$$

$$= 1\left(\cos^2\theta - (-\sin^2\theta)\right) = \cos^2\theta + \sin^2\theta = 1$$

Q2. **Types of Robots**

a) Cylindrical Robots

b) Delta Robots

c) SCARA Robots

d) Cartesian Robots (many Prismatic joints)

e) Collaborative Robots (cobots)

f) Articulated Robots (many Revolute Joints)

g) Polar Robots

Delta robot - https://youtu.be/mLFXOYBJ9Kc
Cylindrical robot - https://youtu.be/Vt84DdK5kTg
Cartesian robots - https://youtu.be/g6BTI0SaUDM
Collaborative robots - https://youtu.be/oXQxM8fE3c0
Articulated robot- https://youtu.be/wNY01XEi_nI
Polar robots - https://youtu.be/5XvdMfXbN-A