

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BRANCH NAME: POWER ELECTRONICS**  
**SUBJECT NAME: SPECIAL ELECTRICAL MACHINES AND CONTROL**  
**SUBJECT CODE: 3712919**  
**M.E. 1<sup>st</sup> SEMESTER**

**Type of course:** Engineering

**Prerequisite:** Fundamental of Electrical Engineering, Electromechanical Energy Conversion, Electromagnetic Laws, Fundamental knowledge of Rotating Magnetic Circuit.

**Rationale:** This course offers knowledge about construction and working principles of different types of Special Electrical Machines. PG students will acquire Torque-Speed characteristics and control of various types of special machines.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE(E)	PA (M)	PA (V)	PA (I)		
3	0	2	4	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs	% Weight
1	<ul style="list-style-type: none"><li>• SYNCHRONOUS RELUCTANCE MOTORS</li></ul> Operating principle, Types, Constructional features: axial and radial air gap Motors, Reluctance torque, Phasor diagram, Motor characteristics.	7	15
2	<ul style="list-style-type: none"><li>• SWITCHED RELUCTANCE MOTORS</li></ul> Principle of operation, Constructional features, Torque prediction, Power controllers, Microprocessor based control, Characteristics, Computer control.	7	15
3	<ul style="list-style-type: none"><li>• STEPPING MOTORS</li></ul> Principle of operation, Constructional features, Types of stepper Motors, Various modes of operation of Variable reluctance (VR) stepper motors, torque production in Variable Reluctance (VR) stepping motor, Multi stack VR stepper motor, Construction and working of Permanent Magnet (PM) stepper motor, Construction and working of Hybrid stepper motor, Torque-angle characteristics of the stepper motor.	7	20
4	<ul style="list-style-type: none"><li>• PERMANENT MAGNET SYNCHRONOUS MOTORS</li></ul> Principle of operation, EMF, power input and torque expressions, Phasor diagram. Power controllers, Torque speed characteristics	7	15
5	<ul style="list-style-type: none"><li>• PERMANENT MAGNET BRUSHLESS DC MOTORS</li></ul> Fundamentals of Permanent Magnets, Principle of operation, Magnetic circuit analysis, EMF and Torque equations,	7	20

	Characteristics and control.		
6	<ul style="list-style-type: none"> <li>OTHER SPECIAL MACHINES</li> </ul> Hysteresis motor, AC series motors, Linear induction motor- Principle of operation, characteristics, and Applications.	7	15

### Reference Books:

1. T.J.E. Miller, Reluctance Motor and their Controls, USA, Oxford University Press, 1995
2. T. Kenjo, Stepping Motors and their Microprocessor Control, England, Clarendon Oxford Press, 1985
3. T. Kenjo and S. Nugatory, Permanent Magnet and Brushless DC motors, England, Clarendon Oxford Press, 1989.
4. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, New Delhi, Prentice, Hall of India, 2009
5. B.K. Bose, "Modern Power Electronics & AC drives", Prentice Hall Publisher, 2002
6. Venkataratnam, "Special Electrical Machines", Taylor and Francis, 2009

### Course Outcome:

After learning the course, the students should be able to:

- Understand the fundamental concepts and the Operation of permanent magnet brushless DC motors
- Understand the basic concepts of other special machines

### List of Experiments:

1. To study construction and operating principle of various types of special machines
2. To study speed torque characteristics of various special machines
3. To study different types of control techniques for various special machines
4. To study speed control of Stepper motor
5. To study speed control of BLDC motor
6. To study speed control of SRM motor
7. Case study of BLDC motor applications
8. Case study of SRM applications

### Major Equipment:

Special Machines as mentioned in syllabus, DSO / Power Oscilloscope with necessary probes, Voltmeter, Ammeter, DMM, PC with necessary simulation software, Appropriate DSP/Microcontroller

### List of Open Source Software/learning website:

1. <https://www.nptel.ac.in>
2. <https://www.mathworks.com/>
3. <https://powersimtech.com>
4. <https://www.scilab.org/>