

## Faculty of Engineering & Technology

### Synchronous Machines

#### Information :

**Course Code :** EPR 541

**Level :** Undergraduate

**Course Hours :** 3.00- Hours

**Department :** Specialization of Electrical Power Engineering

#### Instructor Information :

Title	Name	Office hours
Associate Professor	Moneer Mohamed Ali Abu-Elnaga	2
Teaching Assistant	Abeer Tharwat Said Awad	3

#### Area Of Study :

1. Understand the construction, theory of operation, equivalent circuit, (voltage, current, power and torque) equations, and basic characteristics of each of 3-ph synchronous machines.
2. Demonstrate the load characteristics of 3-ph synchronous generators.
3. Understand the load characteristics and starting methods of 3-ph synchronous motors.
4. Develop practical skills of testing of 3-ph synchronous generators and motors.
5. Understand the theory of operation and load characteristics of 3-ph salient alternators.

#### Description :

Synchronous machines: Theory and design: Introduction, Cylindrical-rotor and salient-pole synchronous machines, Types of windings in ac machines, Winding coefficients, Generator performance, Motor performance, Phasor diagrams, steady state operation, Voltage regulation, Parallel operation, Synchronous machine to an infinite bus, Synchronization process, V curves, Power angle characteristics, Open circuit characteristics, Short circuit characteristics, Potier reactance, Zero-power-factor characteristic, Damper bars, Testing of synchronous machines.

#### Course outcomes :

##### a. Knowledge and Understanding: :

1 -	a1. Demonstrate the construction, theory of operation, and equivalent circuit of 3-ph synchronous machines.
2 -	a2. Understand the load characteristics of 3-ph synchronous generators.
3 -	a3. Understand the load characteristics of 3-ph synchronous motors.
4 -	a4. Describe the starting methods of 3-ph synchronous motors.
5 -	a5. Demonstrate the theory of operation and load characteristics of 3-ph salient alternators.

##### b. Intellectual Skills: :

1 -	b1. Apply knowledge of electromagnetic fields to analyze related problems
2 -	b2. Solve problems related to EMF equation and equivalent circuit of 3-ph synchronous machines.
3 -	b3. Analyze operating conditions of 3-ph synchronous generators.
4 -	b4. Analyze operating conditions of 3-ph synchronous motors.
5 -	b5. Analyze operating conditions of 3-ph salient alternators.

6 -	b6. Choose among different solution alternatives.
<b>c. Professional and Practical Skills :</b>	
1 -	c1. Perform the required experiments to get the load characteristics of 3-ph synchronous generators.
2 -	c2. Perform the required experiments to get the load characteristics of 3-ph synchronous motors.
<b>d. General and Transferable Skills :</b>	
1 -	d1. Work coherently and successfully as a part of a team in the Lab.
2 -	d2. Work in stressful environment and within constraints.
3 -	d3. Communicate effectively.
4 -	d4. Effectively manage tasks, time, and resources.

### **Course Topic And Contents :**

Topic	No. of hours	Lecture	Tutorial / Practical
Construction, theory of operation, and equivalent circuit of 3-ph synchronous machines.	10	6	4
Synchronous generator characteristics: internal and external characteristics, voltage regulation methods. Testing of synchronous machines: OC test and SC test.	10	6	4
Power angle (P- $\delta$ ) characteristics, loading conditions, synchronization, and parallel operation.	10	6	4
Revision on load types, 3-phase system, magnetic circuits, DC Machines.	5	3	2
3-ph Synchronous Motor: Equivalent circuit, phasor diagram, loading conditions, V-curves.	5	3	2
Motor starting, ideal SM at no-load, PF correction. Testing.	5	3	2
3-ph Salient Generators: Equivalent circuit, phasor diagram, solution methods.	10	6	4
Power angle (P- $\delta$ ) characteristics.	5	3	2
Testing of synchronous machines.	15	9	6

### **Teaching And Learning Methodologies :**

Lectures
Tutorials
Laboratories

### **Course Assessment :**

Methods of assessment	Relative weight %	Week No	Assess What
Final exam	40.00		
o In Class Quizzes	10.00		
o Lab	10.00		
o Mid-Term exams	30.00		
o Participations	10.00		

**Recommended books :**

1. "Electric Machinery fundamentals" Chapman, S. J., McGraw Hill Co., 4th edition, 2005 (Text Book).
2. "Principles of Electric Machines with Power Electronic Applications", M. E. El-Hawary, McGraw-Hill, most recent edition.
3. "Electric Machines, Drives and Power Systems", Theodore Wildi, Prentice Hall, most recent edition.