

**Faculty of Engineering & Technology**

**DC Machines and Transformers**

**Information :**

**Course Code :** EPR 444

**Level :** Undergraduate

**Course Hours :** 4.00- Hours

**Department :** Specialization of Electrical Power Engineering

**Instructor Information :**

| Title               | Name                          | Office hours |
|---------------------|-------------------------------|--------------|
| Associate Professor | Moneer Mohamed Ali Abu-Elnaga | 4            |
| Teaching Assistant  | Abeer Tharwat Said Awad       | 2            |

**Area Of Study :**

- Develop the students' knowledge about the construction, theory of operation, equivalent circuit, OC characteristic, external characteristics, and performance of DC Generators and DC motors.
- Train students to perform experiments on performance of DC Generators and DC motors.
- Develop the students' knowledge about the construction, theory of operation, equivalent circuit, external characteristics, and performance of 1-ph Transformers.
- Train students to perform experiments on performance of 1-ph Transformers.
- Prepare students to demonstrate the performance of 3-phase transformer, Auto-transformers and Voltage regulators.

**Description :**

DC machines: Theory and design: The generation of e.m.f., Work, Power, Force torque, The magnetic circuit of the DC machine, Armature windings, Armature reaction, Inductance, Energy in magnetic field, Commutation, Methods of excitation, Load characteristics of DC generators and motors, Efficiency, Testing of DC machines, Special DC machines, Construction of DC machines, Mechanical details, Design.

Transformers: Theory and design: Fundamental concepts, Mutual inductance, Electric and magnetic circuits, Power transformers, Magnetizing current and core loss, Equivalent circuits, Transformers at load, Phasor diagrams, Efficiency, Voltage regulation, Three phase transformers, Three phase transformer connections, Auto transformer, Voltage regulation in auto transformers, Tap changers, On load tap changers, Transformers testing.

**Course outcomes :**

**a.Knowledge and Understanding: :**

|     |  |
|-----|--|
| 1 - | Identify the magnetic circuit definitions and concepts.  |
| 2 - | Demonstrate the construction, theory of operation, equivalent circuit, and characteristics of DC Generators.               |
| 3 - | Describe the construction, theory of operation, equivalent circuit, and characteristics of DC motors.                      |
| 4 - | Compare between different methods of speed control, and methods of starting of DC motors.                                  |
| 5 - | Describe the construction, theory of operation, equivalent circuit, characteristics, and performance of 1-ph Transformers. |

|   |  |
|---|--|
| 6 -   | Describe the testing, and parallel operation of 1-ph transformers.                                       |
| 7 -   | Demonstrate the construction, connections, classification of 3-phase transformers and auto-transformers. |
| <b>b. Intellectual Skills :</b>               |  |
| 1 -   | Solve different types of magnetic systems.   |
| 2 -   | Analyze operating conditions and performance of DC Generators.   |
| 3 -   | Analyze operating conditions and performance of DC motors.   |
| 4 -   | Analyze operating conditions and performance of 1-ph Transformers.                                       |
| 5 -   | Analyze operating conditions of 3-phase transformers.  |
| 6 -   | Choose among different solution alternatives.  |
| <b>c. Professional and Practical Skills :</b> |  |
| 1 -   | c1. Perform the required experiments to get the load characteristics of DC Generators.                   |
| 2 -   | c2. Perform the required experiments to get the load characteristics of DC motors.                       |
| 3 -   | c3. Perform the required experiments to get the load characteristics of 1-ph Transformers.               |
| <b>d. General and Transferable Skills :</b>   |  |
| 1 -   | Work coherently and successfully as a part of a team in the Lab.   |
| 2 -   | Work in stressful environment and within constraints.  |
| 3 -   | dCommunicate effectively.  |
| 4 -   | dManage tasks, time, and resources effectively.  |

**Course Topic And Contents :**

| Topic  | No. of hours | Lecture | Tutorial / Practical |
|--|--------------|---------|----------------------|
| Magnetic systems: definitions, simple systems, complex systems, hysteresis & eddy losses, magnetizing inductance, electric equivalent circuit. | 12           | 6       | 6                    |
| Construction of a DC machine, armature winding, EMF equation.  | 12           | 6       | 6                    |
| Equivalent circuit, types of DC generators, efficiency, open circuit characteristics of a DC generator.  | 12           | 6       | 6                    |
| Testing, external characteristics, and applications of different types of DC generators.   | 12           | 6       | 6                    |
| DC motors: Torque equation, equivalent circuit, types of DC motors, Efficiency.  | 6            | 3       | 3                    |
| Testing, external characteristics, and applications of a DC motors. Starting and speed control. Parallel operation.                            | 6            | 3       | 3                    |
| Transformers:<br>Construction of different types of single-phase transformers, EMF equation, ideal and practical transformers.                 | 12           | 6       | 6                    |
| Exact and approximate equivalent circuits. Transformer losses, efficiency, maximum efficiency, and voltage regulation.                         | 6            | 3       | 3                    |
| Testing and applications.  | 6            | 3       | 3                    |
| 3-phase Transformers: connections, applications. Autotransformers: Construction, theory of operation.  | 6            | 3       | 3                    |

**Teaching And Learning Methodologies :**

Interactive Lecturing

Discussion

Problem solving

Report

Experiential learning

**Course Assessment :**

| Methods of assessment | Relative weight % | Week No | Assess What |
|-----------------------|-------------------|---------|-------------|
| • Final exam          | 40.00             |         |             |
| Mid- Exam 1I          | 15.00             |         |             |
| Mid- Exam I           | 15.00             |         |             |
| o Assignment          | 10.00             |         |             |
| o Lab                 | 10.00             |         |             |
| o Quizzes             | 10.00             |         |             |

**Recommended books :**

1. Chapman, S. J., "Electric Machinery fundamentals", McGraw Hill Co., 5th edition, 2006 (Text Book).
2. M. E. El-Hawary, "Principles of Electric Machines with Power Electronic Applications", Wiley-IEEE Press, 2nd Edition, 2002.
3. Theodore Wildi, "Electric Machines, Drives and Power Systems", Prentice Hall, 6th Edition, 2006.