COURSE : DJJ2022 ELECTRICAL TECHNOLOGY
CREDIT(S) : 2
PRE REQUISITE(S) : NONE

SYNOPSIS

ELECTRICAL TECHNOLOGY exposes students to the basic electrical circuit concepts, the application of electromagnetism in electrical machines and transformers. The course focuses on the different types of electrical circuits, the relationship between current and voltage including the resistance. It also provides the skills on the methods of constructing basic circuits and operation of electrical machines and transformers. This course also exposes the students to the demonstration of experiments in Electrical Technology.

exposes the students to practical laboratory experiments in Electrical Technology

COURSE LEARNING OUTCOMES (CLO)

Upon completion of this course, students should be able to:

1. explain the principles of electrical circuits, electromagnetism, transformers and electrical machines to solve related problems. (C4,PLO2)
2. organize appropriately experiments in groups according to the Standard Operating Procedures. (P4,PLO4)
3. demonstrate continuous learning and information management skills while engaging in independent acquisition of new knowledge and skills in laboratory report. (A3,PLO11)
1.0 INTRODUCTION TO ELECTRICAL CIRCUITS

This topic introduces students to electrical circuits; basic electrical quantities i.e. electromotive force (emf), charge, current, potential difference (voltage) and resistance; types of electrical circuits; open circuit and short circuit. The relationship between current, voltage and resistance. Electrical power, electrical energy and characteristics of series circuits and parallel circuits will also be dealt with.

2.0 INDUCTOR, CAPACITOR, ALTERNATING CURRENT CIRCUITS AND THREE PHASE SYSTEMS

This topic covers Inductors; basic principles, electromotive force i.e. drawings, direction, magnitude, self induction and mutual induction, arrangements in series and parallel circuits and inductors effects. Capacitors; basic principles i.e. definition, units, charges on a capacitor, arrangements in series and parallel and their effects in electrical circuit as well as alternating current circuit, series circuit with R,L and C. Basic principles of three phase system; connections, sinusoidal waveforms, voltage, current and their applications are also discussed.

3.0 BASIC PRINCIPLES OF ELECTROMAGNETISM

This topic examines relationship between current flow and magnetism factors affecting the strength of electromagnets, characteristics of magnetic quantities and electromagnetic induction

4.0 TRANSFORMER

This topic discussed the transformer operating principles; electromagnetic induction concept, relationship between primary/secondary winding, primary and secondary currents, primary and secondary voltages, types and applications of transformers

5.0 AC ELECTRICAL MACHINES

This topic deals with the operating principles of AC generators and motors, characteristics of AC machines, differences between AC and DC machine
6.0 PRACTICAL
In this topic, student will conduct the experiment on electrical circuit, inductor, capacitor and alternating current, three phase system or transformer

*Only five practical task should be carried out from above topics. Choose from any five topics and it would consists one task respectively depend on the lab apparatus in each polytechnic

DEPENDENT LEARNING COURSEWORK ASSESSMENT

RTA – Recommended Time Allocation
SST – Suggested Sequence of Topics
1.0 INTRODUCTION TO ELECTRICAL CIRCUITS

1.1 Apply basic electrical quantities (units and symbols):
1.1.1 Define electrical quantities
   a. Electromotive force (emf)
   b. Charge
   c. Current
   d. Potential energy (voltage)
   e. Resistance

1.1.2 Explain factors that affect the resistance of conductor materials:
   a. Material (resistivity)
   b. Length
   c. Cross-sectional area
   d. Temperature (calculations not included)
   e. Relationship between resistance, length, cross-sectional area and resistivity

1.1.3 Solve problems related to electrical quantities

1.2 Classify types of electrical circuits
1.2.1 Identify simple circuits, complex circuits, open circuits and short circuits
1.2.2 Explain the use of voltmeters, ammeters and ohmmeters with symbols respectively

1.3 Classify Ohm’s Law
1.3.1 Define Ohm’s Law
1.3.2 Explain relationship that voltage is directly proportional to current given that the resistance value is constant
1.3.3 Differentiate between linear and non-linear resistance

1.4 Classify electrical power
1.4.1 Define electrical power
1.4.2 Clarify that electrical power can be delivered as defined by derivation of the voltage and the direction of the current
1.4.3 Solve problems related to electrical power

1.5 Classify electrical energy
1.5.1 Define electrical energy and identify its units
1.5.2 Clarify that electrical energy can be delivered as defined by derivation of electrical power and time
1.5.3 Explain the use of Wattmeter and its symbol
1.5.4 Describe the use of kilowatt-hour meter and its symbol
1.5.5 Explain the relationship between electrical energy and heat energy
1.5.6 Convert units between joule to watt second, kilowatt hour to joule and joule to calorie
1.5.7 Solve problems related to electrical energy
1.6 Classify the characteristics of series and parallel circuits
   1.6.1 Explain formulas used in series circuits and solve problems related to series circuit
   1.6.2 Explain formulas used in parallel circuits and solve problems related to parallel circuit
   1.6.3 Determine Voltage Divider Rule and Current Divider Rule to calculate voltage drop and current drop.
   1.6.4 Explain Series-Parallel Circuit and solve problems related to series-parallel circuit

1.7 Explain Kirchhoff’s Law in complex electrical circuits
   1.7.1 Define and explain Kirchhoff’s 1st and 2nd Law (Kirchhoff’s Voltage law) with the aid of diagrams
   1.7.2 Determine $1_1, 1_2$ and $1_3$ by using simultaneously equation or Cramer’s Method

2.0 INDUCTOR, CAPACITOR, ALTERNATING CURRENT CIRCUITS AND THREE PHASE SYSTEM

2.1 Explain the basic principles of inductors
   2.1.1 Define inductor and identify its unit
   2.1.2 Explain electromotive force (emf) induced from flux cutting
      a. Diagram of emf induced from flux cutting
      b. Direction of emf produced
      c. Emf magnitude produced from changes of flux linkages
      d. Self-inductance and mutual inductance
   2.1.3 Explain inductors in series and parallel circuits to find total inductance
   2.1.4 Explain and provide examples to show the effects of inductors in circuits and appliances
   2.1.5 Determine energy stored by an inductor

2.2 Explain the basic principles of capacitors
   2.2.1 Define capacitor and identify its unit
   2.2.2 Describe and draw a diagram to show existence of charge on capacitor plates
   2.2.3 Explain capacitors in series and parallel circuits to find total capacitance
   2.2.4 Explain the effects of capacitors in electrical circuits
   2.2.5 Determine capacitance and energy stored by a capacitor

2.3 Classify the AC basic circuits
   2.3.1 Describe AC basic circuit characteristics
   2.3.2 Differentiate between in phase waveform and out of phase waveform
   2.3.3 Draw the vector diagram and waveforms of voltage and current
      a. Purely resistive
      b. Purely inductive
      c. Purely capacitive
2.4 Classify series R-L, R-C and R-L-C circuits
2.4.1 State that the supply voltage in a series circuit is equivalent to the total vector of voltages across each component
2.4.2 Draw vector diagram
2.4.3 Differentiate between resistance and impedance
2.4.4 Draw the impedance triangle and calculate impedance
2.4.5 Determine the power delivered in AC circuit

2.5 Explain the basic principles of a three phase system
2.5.1 Define three phase system with the aid of diagram
2.5.2 Differentiate between three phase system and single phase system in terms of:
   a. Connection
   b. Sinusoidal waveform
   c. Voltages and currents
   d. Applications

3.0 BASIC PRINCIPLES OF ELECTROMAGNETISM

3.1 Explain relationship between current flow and magnetism for these cases:
3.1.1 Explain current flow in a single conductor
3.1.2 Explain current flow in two conductors
3.1.3 Classify factors that affect electromagnetic strength in terms of
   a. Current strength
   b. Conductor length
   c. Coil length

3.2 Explain the characteristics of magnetic quantities in electromagnet
3.2.1 Explain the characteristics of magnetic quantities in electromagnet
3.2.2 Solve problems related to magnetic
3.2.3 Explain electromagnetic induction and the factors that affect the value of induced current

4.0 TRANSFORMER

4.1 Explain the principles of transformer
4.1.1 Explain the operating principles of transformer by applying the electromagnetic induction concept
4.1.2 Describe the related formulas by the means of the relationship of:
   a. Primary / secondary windings
   b. Primary / secondary currents
   c. Primary / secondary voltages

4.1.3 Name the various types of transformers and their applications
4.1.4 Explain stepped-down and stepped-up transformers
4.1.5 Solve problems related to transformers
5.0 AC ELECTRICAL MACHINES

5.1 Classify AC electrical machines
   5.1.1 Explain the operating principles of AC generators and motors
   5.1.2 Clarify that the commutator and slip ring are the main characteristics that differentiate between DC and AC generators
   5.1.3 State the differences between DC and AC motors in terms of the operating principles
   5.1.4 Define voltage generated and terminal voltage
   5.1.5 Define synchronous speed, rotor speed and slip
   5.1.6 Solve problems related to AC machines

6.0 PRACTICAL

6.1 Describe the procedures to conduct the experiment in laboratory
   6.1.1 Explain laboratory safety rules and regulation during experiment

6.2 Perform experiments and write appropriate reports related to Electrical Technology:
   6.2.1 electrical circuit
   6.2.2 inductor, capacitor and alternating current
   6.2.3 three phase system
   6.2.4 transformer

6.3 Analyze each experimental data gathered from each experiment

6.4 Apply technical writing format in laboratory report
   6.4.1 Identify sources of measurement uncertainty and quantify measurement error
   6.4.2 Present methods and results technically in laboratory reports and summaries
REFERENCES

Main:


Additional:


### MATRIX OF COURSE LEARNING OUTCOMES (CLO) VS PROGRAMME LEARNING OUTCOMES (PLO)

<table>
<thead>
<tr>
<th>Course Learning Outcome (CLO)</th>
<th>Compliance to PLO</th>
<th>Recommended Delivery Methods</th>
<th>Assessment</th>
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<tr>
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1. **Explain the principles of electrical circuits, electromagnetism, transformers and electrical machines to solve related problems.**

   - **Compliance:** √
   - **PLO:** C4

2. **Organize appropriately experiments in groups according to the Standard Operating Procedures.**

   - **Compliance:** √
   - **PLO:** P4

3. **Demonstrate continuous learning and information management skills while engaging in independent acquisition of new knowledge and skills in laboratory report.**

   - **Compliance:** √
   - **PLO:** A3

**Remark:**
- LD1 Knowledge
- LD2 Practical Skills
- LD3 Communication Skills
- LD4 Critical Thinking and Problem Solving Skills
- LD5 Social Skills and Responsibilities
- LD6 Continuous Learning and Information Management Skills
- LD7 Management and Entrepreneurial Skills
- LD8 Professionalism, Ethics and Moral
- LD9 Leadership and Teamwork Skills
ASSESSMENT

The course assessment is carried out in two sections:

i. **Coursework Assessment (CA) – 50%**
   Coursework is continuous assessment that measures knowledge, practical skills and generic skills. Coursework assessment mark comprises of knowledge and practical marks **ONLY**. It does not include the mark of generic skills.

ii. **Final Examination Assessment (FE) – 50%**
    Final examination is carried out at the end of the semester.

<table>
<thead>
<tr>
<th>COURSE LEARNING OUTCOMES (CLO)</th>
<th>TOPICS</th>
<th>ASSESSMENT METHODS FOR COURSEWORK (CA)</th>
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<tr>
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<tr>
<td>1. Explain the principles of electrical circuits, electromagnetism, transformers and electrical machines to solve related problems.</td>
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<td>2. Organize appropriately experiments in groups according to the Standard Operating Procedures.</td>
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<td>3. Demonstrate continuous learning and information management skills while engaging in independent acquisition of new knowledge and skills in laboratory report</td>
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Test | Quiz | End of Chapter | Practical and Report |
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<td>*(2) 15%</td>
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<td>*(3) 15%</td>
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Remark

Topic 1 : Introduction To Electrical Circuits
Topic 2 : Inductors, Capacitors, Alternating Current Circuits and Three Phase Systems
Topic 3 : Basic Principles Of Electromagnetism
Topic 4 : Transformer
Topic 5 : AC Electrical Machines
Topic 6 : Practical

✓ - Refers to the CLO to be assessed through the indicated assessment task.
*(#) - # refers to the quantity of assessment
**(##) - # refers to the quantity of assessment for generic skill. The generic skill mark is 100% and NOT PART of the coursework mark.
• - Indicates the topic (s) to be covered under the assigned/identified assessment method. For merged topics, lecturers have the choice of covering one particular topic or combinations of topics.
### DISTRIBUTION OF STUDENT LEARNING TIME

**ACCORDING TO COURSE LEARNING - TEACHING ACTIVITY**

<table>
<thead>
<tr>
<th>No.</th>
<th>Learning and Teaching Activity</th>
<th>SLT</th>
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<tbody>
<tr>
<td><strong>DEPENDENT LEARNING</strong></td>
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<td>Preparation before theory class eg: download lesson notes.</td>
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<td>4.1.2</td>
<td>Review after theory class eg: additional references, discussion group, discussion</td>
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<tr>
<td>4.2.1</td>
<td>Preparation before practical class/field work/survey eg: review notes, check list/ labsheets and/or tools and equipment.</td>
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<td>4.2.2</td>
<td>Post practical activity eg: lab report, additional references and discussion session</td>
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<td>4.2.3</td>
<td>Preparation before studio work presentation/critique</td>
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**Remark:**
1. Suggested time for:
   - Quiz : 10 - 15 minutes
   - Test (Theory) : 30 - 60 minutes
2. 40 hours is equivalent to 1 credit