Pusat Pengajian Kejuruteraan Sistem Elektrik
PROGRAM YANG DITAWARKAN

Diploma Kejuruteraan  
(Kejuruteraan Elektrik)

Sarjana Muda Kejuruteraan (Kepujian)  
(Kejuruteraan Sistem Elektrik)

Sarjana Muda Kejuruteraan (Kepujian)  
(Kejuruteraan Elektronik Industri)

Sarjana Sains  
(Kejuruteraan Sistem Elektrik)

Doktor Falsafah

Alamat:

Pusat Pengajian Kejuruteraan Sistem Elektrik  
Universiti Malaysia Perlis (UniMAP),  
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Pusat Pengajian Kejuruteraan Sistem Elektrik menawarkan dua program iaitu Sarjana Muda Kejuruteraan (Kepujian) (Kejuruteraan Sistem Elektrik) dan Sarjana Muda Kejuruteraan (Kepujian) (Kejuruteraan Elektronik Industri). Kedua-dua program yang dijalankan di Pusat Pengajian Kejuruteraan Sistem Elektrik ini menitikberatkan kepada aspek merekabentuk mesin elektrik, peralatan sistem elektrik dan juga peralatan elektronik kuasa untuk kegunaan industri.

Program ini bertujuan melahirkan tenaga kerja di peringkat ikhtisas yang mahir serta mempunyai pengetahuan yang kukuh dalam bidang kejuruteraan sistem elektrik dan elektronik industri. Pelajar akan dilatih untuk menjadi Juruter Elektrik/Elektronik yang berkemampuan menjalankan tugas dalam bidang merekabentuk, penyelidikan dan pembangunan (R&D), penyelenggaraan, jualan, perundangan, pendidikan dan latihan. Para graduan akan berkemampuan menjalankan tugas-tugas pengurusan yang memerlukan kebolehan membuat pertimbangan yang teliti dan tepat.

Pusat pengajian ini berperanan sebagai pemangkin kepada pembangunan industri di kawasan utara khasnya dan kawasan perindustrian lain di Malaysia amnya. Objetif ini dapat dicapai melalui program-program pemindahan teknologi seperti pertukaran staf, latihan dan konsultansi serta perkhidmatan-perkhidmatan lain yang berkaitan dengan kejuruteraan elektrik. Pusat pengajian ini juga bertindak sebagai pusat yang menyeluruhkan hasil penyelidikan, produk inovatif dan khidmat kepada industri dalam bidang kejuruteraan elektrik.

**HASIL PROGRAM (PROGRAM OUTCOMES-PO)**

**PUSAT PENGAJIAN KEJURUTERAAN SISTEM ELEKTRIK**

**PO12**
Berkemampuan untuk menunjukan pengetahuan, merekabentuk sistem dan melakukan uji kaji termasuk juga menganalisis dan mentafsir data dalam bidang sistem kuasa, mesin elektrik dan kejuruteraan voltan tinggi.

*Ability to demonstrate knowledge, design of system and conduct experiments as well as to analyze and interpret data in field of power systems, electrical machine and high voltage engineering.*

**PO13**
Berkemampuan untuk menunjukan pengetahuan, merekabentuk sistem dan melakukan uji kaji termasuk juga menganalisis dan mentafsir data dalam bidang elektronik kuasa industri dan keserasian elektromagnetik (EMC).

*Ability to demonstrate knowledge, design of system and conduct experiments as well as to analyze and interpret data in field of industrial power electronics and electromagnetic compatibility (EMC).*

**PO14**
Berkemampuan untuk menunjukan pengetahuan, merekabentuk sistem dan melakukan uji kaji termasuk juga menganalisis dan mentafsir data dalam bidang penukaran tenaga alternatif dan kawalan sistem tenaga elektrik.

*Ability to demonstrate knowledge, design of system and conduct experiments as well as to analyze and interpret data in field of alternative energy conversion and control of electrical energy system.*
DEKAN

PROF. DR. ISMAIL BIN DAUT

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# Bachelor of Engineering Degree Curriculum (Electrical Systems Engineering)

<table>
<thead>
<tr>
<th>Year</th>
<th>First</th>
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<td>EET101/4 Electric Circuit I</td>
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<td>EET221/3 Power Circuit and Electromagnetic</td>
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<td>EKT100/3 Engineering Skills I</td>
<td>EKT221/4 Digital Electronics II</td>
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<td>EMT112/4 Analog Electronics I</td>
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## Engineering CoPE Courses

- EET101/4 Electric Circuit I
- EET102/4 Electric Circuit II
- EKT120/4 Computer Programming
- EKT100/3 Engineering Skills I
- EKT121/4 Digital Electronics I
- EKT221/4 Digital Electronics II
- EKT200/3 Engineering Skills II
- EKT230/4 Signals and Systems
- EKT222/4 Microprocessor System
- EMT111/4 Electronic Device
- EMT112/4 Analog Electronics I
- EMT212/4 Analog Electronics II
- EKT231/4 Communication Systems
- EQT101/3 Engineering Mathematics I
- EQT102/3 Engineering Mathematics II
- EQT203/3 Engineering Mathematics III
- EKT241/4 Electromagnetic Theory
- EKT364/4 Control Systems

## Industrial Entrepreneurship (2 Days)

- EET305/4 Power System Fundamental
- EIT300/6 Industrial Training
- EET408/4 Power System Analysis and Control
- EET413/4 High Voltage Engineering
- EET306/4 Electrical Machine
- EET412/3 Electrical Machine Design
- EET415/4 Power System Operation
- EET307/4 Power Electronics I
- EET414/3 Substation Design
- EET444/6 *Final Year Project
- ENT364/4 Control Systems
- EET444/6 *Final Year Project
- EUT440/3 Engineers in Society

## University Required Courses:
Engineering Entrepreneurship, Thinking Skills, University Malay Language, University English, Islam & Asia Civilisation (TITAS), Ethnic Relation, Co-Curriculum and Option Subjects.

## Total Units for Graduation

- 135

*Course begins in the first semester but total credits are given upon completion of the second semester.*
<table>
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<tr>
<th>YEAR</th>
<th>FIRST</th>
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<td>FIRST</td>
<td>EET101/4 Electric Circuit I</td>
<td>EET102/4 Electric Circuit II</td>
<td>EET204/3 Instrumentation &amp; Measurement</td>
<td>EET221/3 Power Circuit and Electromagnetic</td>
<td>EET305/4 Power System Fundamental</td>
<td>EIT300/6 Industrial Training</td>
<td>EET421/4 Power Electronics Drive</td>
<td>EET422/3 Electromagnetic Compatibility (EMC) And Compliance Engineering</td>
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<tr>
<td>INDUSTRIAL EXPOSURE (IndEx) - 1 WEEK</td>
<td>EMT111/4 Electronic Device</td>
<td>EKT121/4 Digital Electronics I</td>
<td>EKT230/4 Signals and Systems</td>
<td>EKT222/4 Microprocessor System</td>
<td>EKT307/4 Power Electronics I</td>
<td>EKT424/3 Power Electronics For Energy System</td>
<td>EKT440/3 Engineers in Society</td>
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<tr>
<td>INDUSTRIAL ENTREPRENEURSHIP (2 DAYS)</td>
<td>EQT101/3 Engineering Mathematics I</td>
<td>EQT112/4 Analog Electronics I</td>
<td>EMT212/4 Analog Electronics II</td>
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**UNIVERSITY REQUIRED COURSES:**
Engineering Entrepreneurship, Thinking Skills, University Malay Language, University English, Islam & Asia Civilisation (TITAS), Ethnic Relation, Co-Curriculum and Option Subjects.

**Total Units for Graduation:**
135

*Course begins in the first semester but total credits are given upon completion of the second semester.*

**Course Code**
Ex: ABC123/4
(A: Degree/Diploma Programme) ; (B: School) ; (C: Type of Courses) ; (1: Stage (Stage1, 2, 3 & 4)) ; (2 & 3: Course number) ; (/4: unit)
EET101/4 ELECTRIC CIRCUIT I

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
- Understanding of circuit elements
- Do circuit analysis using circuit analysis methods on DC and AC circuits
- Understanding of AC system concept
- Understanding of three phase system concept

SYLLABUS

Variables and Circuit Elements
Revision of SI unit, Voltage and current, Power and energy, Ideal basic circuit elements (passive and active), Basic circuit connections, Application of Ohm’s Law and power calculation with passive sign convention, Kirchhoff’s Laws

Resistive Circuits
Series/parallel equivalent circuits, Voltage divider rule, Current divider rule, Voltage and current measurements, Wheatstone bridge, Delta (or Pi) and Wye (or Tee) equivalent circuits

Methods of Circuit Analysis and Circuit Theorems
Introduction to Nodal Analysis (Node-Voltage), basic concept and analysis steps on simple circuits and special cases circuits (involved dependent sources and voltage sources) in Nodal Analysis, Introduction to Mesh Analysis (Mesh-Current), basic concept, analysis steps on simple circuits and special cases circuits (involved dependent sources and current sources) in Mesh Analysis, Superposition theorem, Thevenin and Norton equivalent circuits, Source transformation and maximum power transfer

Inductance and Capacitance
Inductor, relationships between voltage, current, power and energy for inductor, Capacitor, relationships between voltage, current, power and energy for capacitor, Series/parallel combination of inductor and capacitor

First Order and Second Order Responses of RL and RC Circuits
Natural responses and unit step responses of RL and RC Circuits, General solutions of natural responses and unit step responses, Sequential switching, introduction to natural responses and unit step of RLC circuits, natural responses and unit step responses of series/parallel RLC circuits

Sinusoidal Steady State Analysis
Introduction to sinusoidal waves (sources and responses), phasor concept and phasor diagram, Circuit elements in phase/frequency domain (relationship between V-I for R, L, C), Impedance and reactance and methods of circuit analysis in phase/frequency domain

Power calculations and Power Factor Correction
Introduction to instantaneous power, average (active) power and reactive power, Power calculations and rms values, Complex power and power triangle, maximum power transfer in impedance term

Balanced Three-phase Systems
Introduction to single-phase and three-phase systems, Balanced three-phase voltages, three-phase voltage source and relationship between line and phase voltages and currents (Star/Delta connected systems), source and load connections and power calculations in three-phase systems

PRACTICAL: LIST OF EXPERIMENTS
1. Introduction to basic laboratory equipment.
2. Series/parallel resistance and kirchhoff’s law.
4. Thevenin’s and Norton’s Theorem.
5. Inductor and capacitor.
8. Sinusoidal steady-state analysis using mesh current method.
9. Sinusoidal steady-state analysis using
node voltage method.
10. Load characteristics, maximum power transfer, sinusoidal steady-state power calculations and power factor correction.

REFERENCES
Text Book:

REFERENCES:

EET102/4 ELECTRIC CIRCUIT II

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
- Understanding of Laplace Transform concept
- Do circuit analysis using Laplace Transform method
- Understanding of frequency response concept for AC circuit
- Understanding of Fourier series
- Do circuit analysis using Fourier Transform
- Understanding of two port network

SYLLABUS

Mutual Inductance
A review of self-inductance, The concept of mutual inductance, Polarity of mutually induced voltages (dot convention), Energy calculation, Linear and ideal transformer, Equivalent circuit for magnetically coupled coils, Ideal transformer in equivalent circuit

Introduction to Laplace Transform
Definition of the Laplace Transform, The step function, The impulse function, Functional transform, Operational transform, Inverse Laplace Transform, Poles and zeros of F(s), Initial- and Final-Value Theorem

The Laplace Transform in Circuit Analysis
Circuit elements in the s-domain, Circuit analysis in s-domain, The transfer function, The transfer function in partial fraction expansion, The transfer function and the convolution integral, The transfer function and the steady-state sinusoidal response, The impulse function in circuit analysis.

Frequency Response in AC Circuit
Frequency response (magnitude and phase plot, pass band, reject band), Cutoff frequency types of typical filters, RL and RC low-pass filter, RL and RC high-pass filter, RLC bandpass filter (resonance frequency, bandwidth and Q factor), RLC bandreject filter (resonance frequency, bandwidth and Q factor), Frequency response using Bode Diagrams (complex poles and zeros

Fourier Series

Fourier Transform
The derivation of the Fourier Transform, The convergence of the Fourier integral, Relationship between Laplace Transform and Fourier Transform, Fourier Transform in limit, Mathematical properties for Fourier transform, Circuit analysis using Fourier transform, Parseval’s Theorem, Energy calculation in magnitude spectrum

Two-Port Circuits
The terminal equations, Two-port parameters (Z, Y, A, B, H, G), Relationships among the two-port parameters, Analysis of the two-port circuit with load, Relationship between two-port circuit (cascade, series, parallel, series-parallel, parallel-series)

PRACTICAL: LIST OF EXPERIMENTS
1. Introduction to Pspice
2. Linear and ideal transformer simulation
3. Introduction to Laplace transform
4. Laplace transform in circuit analysis
5. RC and RL filter
6. Bandpass and bandstop filter
7. Fourier series in RL circuit analysis
8. Fourier series in RC circuit analysis
9. Fourier transform in RL circuit analysis
10. Fourier transform in RC circuit analysis

REFERENCES
Text Book:

REFERENCES:

EET103/4 ELECTRICAL TECHNOLOGY

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
- Identify principle elements (R, L and C) and describe the basic electrical quantities (voltage, current, work and power
- Analyze simple DC and single phase and three phase AC circuits
- Explain the basic concept of magnetism and electro magnetism and its application in DC and AC machines

SYLLABUS

Basic concept and DC circuit
Electromagnetic
Faraday Law, Flemming, Magnetic field, Magnetik material, Magnetisation curve, Magnetic Equivalent Circuit, electromagnetic induction, Sinusoidal excitation, Lenz’s law, Magnetic losses, eddy current, hysteresis

AC Circuit
Sine wave, frequency, amplitude, phase angle, complex number, Impedance, inductance, capacitor, inductor, Current, voltage, active power, reactive power, power factor, Ohm’s law, KCL, KVL, Source Transformation, Thevenin theorem.

Three phase system
Single phase system, Three phase voltage generation, phasor diagram, Three phase connection: Wye and Delta, Line/phase voltage and current calculation, Active and reactive power calculation, power factor correction.

Transformer

DC and AC Machines

REFERENCES
Text Book:

REFERENCES:

EET204/3
INSTRUMENTATION & MEASUREMENT

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
• Understand the principles of basic measurement and instrumentation
• Understand the techniques of electrical measurement
• Understand the basic principle of measurement using transducers
• Gained experimental competence and deepened understanding of selected topics through laboratory experiments

SYLLABUS
Basic concepts of instrumentation and measurement
Introduction to measurement process and instrumentation; Standards and calibration; Classification of instruments; Characteristics of instruments; Error; Types of errors; Statistical analysis of error in measurement; Limiting error

Direct current meters
Construction and function of Permanent magnet moving coil (PMMC) or D’Arsonval meter; D’Arsonval meter movement used in a DC ammeter; Multiple range ammeter (Ayrton shunt); Ammeter insertion effects, Multiple range ammeter (Ayrton shunt); Ammeter insertion effects, Ohmmeter, Earthing resistance measurement using Murray’s method, Earthing resistance measurement using Varley’s method, Insulation resistance measurement

Alternating current meters
D’Arsonval meter movement used with half wave rectification; D’Arsonval meter movement used with full wave rectification; AC ammeter, Reactive power measurement using wattmeter, Instrument transformer: Current transformer, voltage transformer, Power measurement without wattmeter: Three voltmeters method, Three ammeter methods

Oscilloscopes
Introduction to construction and basic function of Cathode Ray Tube (CRT); Types of oscilloscope; Measurement of voltage, frequency and phase; Lissajous figure

DC bridges
Construction and principle operations of DC bridges; Wheatstone bridge; Kelvin bridge, Earthing resistance measurement using Murray’s method, Earthing resistance measurement using Varley’s method, Insulation resistance measurement

AC bridges
Construction and principle operations of AC bridges; Maxwell bridge; Opposite angle bridge (Hay bridge), Schering bridge and Wein bridge

Sensor and transducer
Introduction to sensor and transducer; Temperature transducer; Light transducer; Optic sensor; Fluids flow measurement, Distance measurement transducer; Torque and pressure measurement; Resistive strain transducer; Level transducer

PRACTICAL: LIST OF EXPERIMENTS
1. Error in measurement
2. D’Arsonval Galvanometer
3. Basic voltmeter design
4. Wheatstone bridge
REFERENCES
TextBook:

REFERENCES:

EET211/3
Electrical Engineering Principle

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
- Understanding of some elementary law to use on electrical machine and transformer
- Understanding of magnetism and electromagnetic that happened on electrical machine and transformer
- Understanding basic principle of electrical machine and transformer
- Do analysis by using conventional method on electrical machine and transformer

SYLLABUS

The per unit system
Review of electrical system basic concept, Ohm’s law, Electrical power, Kirchhoff’s laws introduction per unit system, Modeling of interconnection power system, Voltages and current in the Wye (Y) connection, Voltages and currents in the delta (? ) connection

Magnetism and Electromagnetic

Single Phase Transformer
Basic Principle, Basic Structure, Magnetic Core, Primary and Secondary Windings, Transformer Design, E.M.F. Equation of a Transformer, Ideal Transformer, Equivalent Circuit of a Transformer, Loss in Transformer, Efficiency of Transformer

Three Phase Transformer
Three Phase Transformers, The basic principle of a 3 phase transformer, Basic Structure Three phase transformer connections, Auto transformer

DC Generator
Principle, E.M.F. Equation of a Generator, DC General Construction, Armature Winding Armature Reaction and Commutation, Operation DC Generator, The Basic Analysis of DC Generator, Iron Loss in the Armature Core, Total Loss in a DC Generator

DC Motor
Principle, Inside an Electric Motor, Operation, Torque (T), Armature torque (Ta), Shaft Torque (Tsh), Starting of DC Motor, Speed of a DC Motor, Speed regulation, Factors controlling the speed

Alternator
Introduction, Basic principle, Construction, Speed and Frequency, Pitch factor (kc), Winding factor or distribution factor (kd), Equation of Induced e.m.f., Three phase Alternator, The connecting coil

Induction Motor

Single Phase Motor

PRACTICAL: LIST OF EXPERIMENTS
1. DC generator using permanent magnets
2. Characteristics of separately excited DC generator
3. Characteristics of DC series motor
4. Characteristics of DC shunt motor on no load condition
5. Short-circuit and open-circuit tests of a transformer
6. Principle of a three phase synchronous generator and no-load characteristic
7. Principle of 3-phase induction motor
8. Principle of a single phase induction motor
9. Shaded-pole motor & universal motor
10. Three phase synchronous generator winding and no-load connection

REFERENCES
TextBook:

REFERENCES:
EET221/3
POWER CIRCUIT AND
ELECTROMAGNETIC

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
• Ability to demonstrate knowledge and understanding of construction and principles of operation of electrical machine
• Ability to analyse simple problems related to operation of electrical machines
• Ability to compare and contrast the operation of different types of electrical machines
• Ability to formulate relevant equivalent circuits

SYLLABUS

Three phase circuits and three phase power
Characteristic in three phase circuits, Analysis in three phase circuits, Power calculations in three phase circuits, Measurement of current, voltage and power in three phase circuits, Power calculations in three phase circuits, Measurement of current, voltage and power in three phase circuits

Magnetic materials and circuits
Fundamentals of electricity, magnetism and circuits, Induced voltage and torque in electrical machines

Power Transformers
Types of power transformers, Elements of power transformers, General theory and principle of transformer operation, The ideal transformer model, Non ideal transformer and the exact equivalent transformer model, The approximate transformer circuit model, Transformer characteristics, The three phase transformer, Measuring transformer quantities – open circuit test and short circuit test

DC Machine
Basic construction, Armature winding and voltage, DC machine operates as a generator, DC machine operates as a motor, Induced torque, Power flow and losses in DC machine, DC machine equivalent circuit, Magnetizing curve, Analysis in DC motor, Analysis in DC generator

AC Machine (Induction machines)
AC machines fundamentals, AC machines basic construction, Induction motor concept, Induction motor equivalent circuit, Power and torque calculation in induction motor

AC Machine (Synchronous machines)
Synchronous machine construction, Synchronous machine speed calculation, Internal generated voltage, Development of a model for armature reaction, The phasor diagram, Power and torque calculation in synchronous generator, Open circuit and short circuit model parameter for synchronous generator, Conditions for parallel operation of generator, Basic principles of synchronous generator, synchronous motor equivalent circuit

PRACTICAL: LIST OF EXPERIMENTS

REFERENCES
Text Book:

REFERENCES:

EET305/4
POWER SYSTEM FUNDAMENTAL

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
• Understanding of parts of electrical power system
• Understanding load forecasting on the power system
• To do fault analysis using symmetrical component method on power system
• To design relay protection in electrical system

SYLLABUS

Basic Principle
Introduction, Review of electrical system concepts, System voltages, The per-unit method, General layout of the system

Power Generation
Modern power system, Hydrology process, Fossil fuel power plant, Nuclear power plant, Solar thermal power plant, Wind power plant

Transmission Lines
Introduction, The transmission parameters, Types of conductors and conductors material
Inductance and inductive reactance, Capacitance and capacitive reactance, Transmission line models, The short transmission line, The medium length transmission lines, The long transmission line, The ABCD model, The effect of load changes on a transmission line, Power flows in a transmission line, Transmission line efficiency

Distribution System
Introduction, Sub transmission, Distribution substations, Primary system, Distribution
transformer, Voltage drop calculations

**The Load In Power System**
- Introduction, Load forecasting, Load characteristic, Power and power factor, Electric power quality

**Faults In Electrical System**
- Introduction, Transients during a balance fault, The method of symmetrical components, Power in symmetrical components, Sequence networks, Line to ground fault, Double line to ground fault, Line to line fault, The balanced three phase fault

**Protection In Electrical System**
- Introduction, Protective relays, Electromechanical relays, Transformer protection, Transmission line protection, Pilot wire feeder protection, Impedance based protection principles, Computer relaying, Fuse, Circuit breaker

**Surge Arrester**
- Stroke leader, Lightning, Utility surge arrester

**PRACTICAL: LIST OF EXPERIMENTS**
1. Line and cable parameter calculation
2. Long term load forecasting
3. Short circuit studies
4. Relay co-ordination
5. Operation distribution
6. Familiarization & test equipment for distribution network
7. OC relay setting
8. Power factor correction
9. Introduction scada
10. Tap changer operation transformer

**REFERENCES**
**Text Book:**

**REFERENCES:**

**EET306/4 ELECTRICAL MACHINE**

**COURSE OUTCOMES**
Upon successful completion of the course the students should be able to:
- Understands the principle of electromechanical energy conversion, the application of this in different AC machines.
- Demonstrate an advanced understanding of construction, operation, cooling and paralleling transformer and the performance and characteristics of electrical machines.
- Apply the concepts to real-world applications.
- Hands on experience with some of these modules.

**SYLLABUS**

**Three Phase Transformer**
Review: Ideal transformer, Equivalent circuit, Efficiency, Three phase Transformer Connections: Transformer Polarity and Standard Terminal Markings, Three phase Transformer and winding arrangement, Transformer Nameplates

**Three Phase Transformer**
Parallel Operation of Transformer: Load Division Between Transformers in Parallel

**Three Phase Transformer**
Transformer problem of Transformer In Rush Current and Harmonic in Three Phase Transformer, Ancillary Equipment of Transformer Cooling Methods and Tap Changing Transformers

**DC Machines**
- Basic principles of operation DC motor, Types of DC motor, DC motor analysis, DC motor performance: Efficiency, Basic principles of operation DC generator, Types of DC generator, DC generator analysis, DC generator performance: Efficiency, Motor starting, DC machine dynamic

**Three Phase Induction Machines**
- Constructional features of squirrel cage rotor and wound rotor motors, Theory and operation, Torque-speed characteristics, Speed control of induction motor, Classes of squirrel cage motors, Starting Induction Motor

**Single Phase Induction Motors**

**Synchronous Machines**
- Constructional features of cylindrical and salient pole rotor generators. Theory of operation of cylindrical and salient pole generators, equivalent circuit, Measuring synchronous generator model parameter, synchronization, active and reactive power sharing between parallel generators

**Electrical Machines Selection and Control**
- Types of Power Transformer, Instrument Transformer, Motor Selection, Motor Control

**PRACTICAL: LIST OF EXPERIMENTS**
1. Single phase transformers-transformer regulation
2. Three phase transformer – voltage and current relationship
3. Separately excited dc generators
4. Separately excited, series, shunt and compound dc motors Squirrel cage induction motor
5. Starting single phase induction motors – split phase, capacitor start and shaded pole motors
REFERENCES
Text Book:


REFERENCES:

EET307/4
POWER ELECTRONICS I

COURSE OUTCOMES
- Power Electronic Systems; Ability to explain power electronic systems operation, applications area and need for efficiency design.
- Power Semiconductor; Ability to comparative understanding of power semiconductor parameters in the design and thermal management of power electronic converters. Ability to understand power rectifier, SCR, Triac and MOSFET, gate drive requirement and circuit implementation design.
- Linear regulator and DC-DC Converter; Ability to understand, select and design around linear regulator. Ability to understand DC-DC converter as the basis of SMPS converter.
- Power processing systems; Ability to analyze and design AC-DC converter, AC-AC converter and DC-DC converter.
- Introduction to Power Quality and EMC (Line Current Harmonics); Ability to understand the design need of power quality related EMC compliance.

SYLLABUS

Power Electronic Concepts
Power Electronics Overview: Introduction to Power Electronics & the basics of Power Processing

Power Supply Technology
Linear Regulators
EMC: Line current harmonics

PRACTICAL: LIST OF EXPERIMENTS
A mix of Hardware and Software experiments + demos selected from

Hardware
1. Lab 1. SCR Gate Controller
2. Lab 2. AC-DC Rectifier with R, R+L and FWD loads 3. Lab 3. AC-DC SCR with R, R+L and FWD loads
4. Lab 4. AC-DC FW CR, R load
5. Lab 5. AC-AC Converter, R load
6. Lab 6. AC-AC Converter Series R L load
7. Lab 7. DC-DC Converter
8. Lab 8. AC-DC, C load – Line Current Harmonics
9. Lab 9. Linear Regulators

Software
1. MCAD Power Electronic Waveforms
2. MCAD SCR HW: R, R+L & FWD waveforms
3. MCAD AC-AC R+L waveforms

REFERENCES
Text Book:

REFERENCES:

EET408/4
POWER SYSTEM ANALYSIS AND CONTROL

COURSE OUTCOMES
Upon successful completion of the course:
- Student should be able to calculate Power-flow in System with the method of:
  1. Gauss-Seidel

Power Semiconductor Devices
Comparative overview of power semiconductor devices

Introduction to Power Rectifiers
Thyristors: Silicon Controlled Rectifier (SCR) & Triac

Power Mosfets
Gate drive requirements and circuit implementation

Power Processing:
1. AC-DC Converters
   Controlled Rectification
   Phase Angle Control single phase half-wave and full-wave bridge (battery, resistive, series inductive inc. ‘freewheel diode’ loads)

Design:
Using performance nomograms
EMC: Line current harmonics and line conducted interference (switching & overlap)

Power Processing:
2. AC-AC Converters
   Phase Angle Control single-phase AC controllers (resistive, series inductive loads)

Design:
Using performance nomograms
EMC: Line current harmonics

Integral Cycle Control
Triac applications

Power Processing:
3. DC-DC Converters
   DC-DC converter basics as a preliminary to SMPS (resistive, series inductive and ‘freewheel diode’ loads)

Thermal Management
Principles and Methods

Design:
Co-relating heat sink and power semiconductor data
2. Newton-Raphson
3. Decoupled
4. Fast-Decoupled
- Student should be able to analyze the Optimal Power-Flow
- Student should be able to explain about Control Power system
- Student should be able to calculate fault current in Symmetrical and Unsymmetrical Fault
- Student should be able to analyze stability system by means:
  1. Equal-Area
  2. Step-by-Step

SYLLABUS

Introduction to Power System Analysis
Introduction, Single-line diagram, Impedance diagram, Admittance diagram, Per-unit system. The problem in power system are Load flow, Optimal power flow, Symmetrical Fault, Unsymmetrical fault and Stability,
Arrange the Bus Admittance and Impedance Matrix
Bus Admittance Matrix, Bus Impedance Matrix

Power flow solution

Optimal Power Flow
Economic Operation of power system, Definition in economic operation, Characteristic of unit thermal generation, Economic dispatch in system without transmission losses by means Lambda method, Economic dispatch in system with transmission losses by means Lambda method, Automatic Generation Control, Q – V control, P – f Control

Symmetrical fault
Types of fault, Process of fault, Fault calculation using of Internal Voltage and Thevenin Theorem, Fault calculation using: Zbus equivalent, The selection of Circuit breaker

Symmetrical Component
Introduction, Synthesis of Unsymmetrical phasors from their symmetrical Component, The symmetrical component of unsymmetrical phasor, Symmetrical Y and ? Circuit, Sequence Circuits of Y and ? impedance, Sequence Circuits of Transformer, Unsymmetrical Series Impedances, Sequence Networks

Unsymmetrical Fault
Unsymmetrical Fault on Power System, Single line-to-Ground Faults, Line-to-Line Faults, Double line-to-Ground Faults, Fault Calculations in Large Scale Systems, Open-Conductor faults

Stability

PRACTICAL: LIST OF EXPERIMENTS
1. Analysis the power flow with Gauss-Seidel Method
2. Analysis the power flow with Newton-Raphson Method
3. Analysis the power flow with Fast-Decoupled Method
4. Optimal power flow
5. Analysis the symmetrical fault problem
6. Analysis the unsymmetrical fault
7. Transient stability due to symmetrical fault

REFERENCES
Text Book:

REFERENCES:
synchronous machines, Losses, efficiency and temperature rise

**Induction motors**
Construction, The stator, The Rotor, Motor characteristic, Analysis

**Transformers**
Construction, Core, Windings, Operating Characteristic, Analysis

**PRACTICAL: LIST OF EXPERIMENTS**
1. Measurement of loss in the material on rolling and transverse direction
2. Measurement of loss on the material using Epstein tests
3. Introduction of FEM
4. General layout of motor
5. Rewind Motor of motor
6. Test Run motor
7. Design transformer core
8. Design transformer winding

**REFERENCES**
Text Book:

**REFERENCES:**

**EET413/4**
**HIGH VOLTAGE ENGINEERING**

**COURSE OUTCOMES**
Upon successful completion of the course the students should be able to:
- Catch up the concept of high voltage engineering and its practical applications to the real world
- Master the understanding of generations & measurements of high voltage and current principles
- Understand over-voltage phenomena and the related insulation coordination problems & to carry out high voltage testing for electrical apparatus

**SYLLABUS**

**Introduction to high voltage engineering**
Electric field stresses, Gas/vacuum as insulator, Liquid Dielectrics, Solids & composites, Estimation & control of electric stress, Surge voltages their distribution & control

**Conduction & Breakdown in Gases**
Ionization process, Townsend’s criteria for breakdown in non-uniform fields & corona discharges, Post breakdown phenomena & gas mixtures for insulation, Vacuum insulation

**Conduction & Breakdown in Liquid Dielectrics**
Liquids as insulators, Pure liquids and commercial liquids, Conduction & breakdown in pure liquids, Intrinsic breakdown, Electro-mechanical breakdown

**Breakdown in Solid Dielectrics & Application of Insulating Materials**
Thermal breakdown, Breakdown in solid dielectrics in practice, Breakdown in composite dielectrics, Applications in power transformers, Applications in rotating machines

**Breakdown on Solids & Insulating Materials**
Applications in circuit breakers, Applications in power capacitors, Applications in high voltage busings, Applications in fractional horse power motors

**Generation of High Voltages & Currents**
Generation of direct current voltages & generation of AC voltages, Generation of impulse voltages & generation of impulse currents, Deriving the R-C parallel circuits, Tripping and control of impulse generators

**Measurement of High Voltage & Currents**
Measurement of DC voltages & measurement of AC impulse voltages, Measurement of DC currents & measurement of AC impulse currents, Measurement of High Voltage & Currents Cathode Ray Oscillographs for impulse voltage and currents

**Over-voltage Phenomenon & Insulation Coordination in Electric Power Systems**
Causes of over-voltages – lightning phenomena, switching surges, system faults, Insulation coordination on high voltages, extra and ultra high voltages systems

**Non-destructive Testing of Materials & Electrical Apparatus**
Measurement of DC resistivity, Measurement of dielectric constant, Measurement of loss factor, Measurement of partial discharge (PD)

**High Voltage Testing of Electrical Apparatus**
Testing of insulators & bushings, Testing of isolators & circuit breakers, Testing of cables, transformers, surge arrestors & audio interferences

**PRACTICAL: LIST OF EXPERIMENTS**
2. Generation of direct current voltages, generation of AC voltages and generation of impulse voltages & impulse currents.
5. High Voltage Lines Terminated with: Resistors, Inductors, capacitors and Transformers.
7. Testing of 33 kV ACSR Cable.
8. High Voltage Testing of Electrical
Apparatus.

REFERENCES
Text Book:

REFERENCES:

EET414/3
SUBSTATION DESIGN

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
- Explain aspects of the fundamentals and considerations of substation design
- Apply, operate and maintenance basic principle of substation equipments part and its function.
- Measurement of resistivity and grounding resistance; design and analysis of simple ground grid substation and safety requirement
- Define protection of substation equipments caused by internal fault (short circuit) and external fault (lightning)
- Explain and carry out principles some of substation equipment part testing

SYLLABUS

Introductions
Overview of the substations design, Construction process, Substation design consideration, Substation type and purpose, Parts of substations

Bus Configuration And Design
Bus-Bar Configuration/ Switching Arrangement, Comparison of configuration, Design of Bus-bar, Force due to short circuit, Bending load of Insulator, Spacing of

Substation Equipment
Circuit Breaker and Bus-bar, Disconnecting Switches, Load Breaking Switch and Earthing Switch, Substation Transformer, CT and PT, Lightning Arrester, Current Limiting Reactor and Capacitor, GIS and Switchyard

Grounding And Ground Grid Design

Protective Relaying And Control
Types of Relays and Applications, Protective Relay Schemes for Substation Equipment, Substation Transformer Protections, Lines Protection, Bus-bar Protection, Protections of Reactor, Capacitor, etc

Lightning And Insulation Coordination
Lightning Parameter, Empirical Design Method, Electrogemetric (EGM) Model, Insulation Level and Margin Protection, Selection and Location of Lightning Arrester

Substation Communications
Supervisory Control and Data Acquisition (SCADA), SCADA Functional and Communication Requirements, Component of a SCADA System, Security for Substation Communications, Auxiliary

Substation Auxiliary Power Suply And Building Service
DC Supplies: Battery etc, AC Supplies: Power Sources, LV Switchboard, Uninterruptible Power Supplies (UPS), Fire Fighting

Substations Sitting And Sizing
Substation Locations, Capacity and Service Area, Substations Sitting, Environment issue and Sizing Economics, Guidelines to Achieve Low Cost in Substations Sitting and Sizing

Foundations And Structure /Civil Work
Grading and Drainage, Foundation, Cable Duct, Structure for Substations, Control House and Office Building

Testing And Commissioning

PRACTICAL: LIST OF EXPERIMENTS
1. Introduction To Substation
2. Operation and Maintenance Substations Equipment Part
3. Resistivity and Resistance Grounding Measurement
4. Computer Aided Ground Grid Substations Analysis
5. Relay Test and Setting
6. Equipment Testing
7. Field Study

REFERENCES
Text Book:

REFERENCES:

EET415/4
POWER SYSTEM OPERATION

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
- Explain, define and describe the problem in optimal load dispatch power system operation based on generation and transmission
• Explain and analyze optimal load dispatch power generating technique as well as transmission in power system
• Analyze and explain unit commitment energy generation and costing system of energy transmission and distribution
• Analyze interconnection communication and SCADA system in power system
• Investigate contingency study

SYLLABUS

Introduction to Power System Operation

Energy Generation and Transfer in Power System
Introduction, Energy source, Power system behavior, Energy transfer, Types of generator
Load distribution within generator, Parallel operation of AU synchronous machine, Parallel operation of power system

Economic Power System Operation
Introduction, Power system operates at constant cost and variable cost, Thermal power plant efficiency, Rate of increasing economic load on generator unit, Effect of fuel cost changes, Nuclear, geothermal, solar, and wind generation, Thermal and hydro generator coordination, Power loss on transmission line, Economically energy transfer

Optimal Dispatch Energy Generation
Introduction, Nonlinear function optimization, Thermal plant operation cost, Economic dispatch, To prove losses formula in generation, Unit commitment (UC), Importance of discrimination commitment unit, Techniques uses in unit commitment, Linear Technique Nonlinear technique

Interconnection Power System Operating
Introduction, review on frequency-power and voltage, reactive characteristics of a synchronous generator, operation of generators in parallel with large power systems, operation of generators in parallel with other generators of the same size,

Economic Interchange Between Interconnected Utilities, Tie-line Interchange Between Interconnected Utilities, Frequency Dependent Load Flow, Flat Tie Line And Flat Frequency Control

Communication in Power System
Introduction, Communication system advance in power system, Audio communication and carrier system in power transmission line, Coupling of carrier system power line to power line and related issues, SCADA system in power system

Contingency Study
System security, factors affecting security, contingency analysis, security analysis, sensitivity factors, ac power flow methods, contingency selection, concentric relaxation, bounding, sensitivity methods

PRACTICAL: LIST OF EXPERIMENTS
1. Contingency in load flow
2. Economic power flow
3. Dynamic Stability
4. Reactive Power Optimization
5. Tie Line Scheduling
6. Load Shedding

REFERENCES
Text book:

REFERENCES:

EET421/4
POWER ELECTRONICS DRIVE

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:

- Understanding of power electronic drives and load characteristics
- Knowledge of power electronic drives and its relation to electrical load, especially to electrical machine loads
- Good choice of power electronic drives for electrical machines applications
- Awareness of future trends in power control for power electronic drives

SYLLABUS

Introduction to Power Electronic Drives
Power Electronic Drives History, Power switches, Power Electronic Systems and Applications, Converter Modeling and Control, General design of power electronics equipment

Dynamics of Electrical Drives
Load Characteristics, Load with Rotational Motion, Load with Translational Motion, Components of Load Torques, Nature and Classification of Load Torques

AC to DC Converter
AC to DC Conversion, Rectifier, Direct Current Filtering Methods, Voltage multiplier, Direct Current Regulating Methods, Battery Charger, Single Phase Series of Semi Converters, Single Phase Series of Full Converters, Single Phase Dual Converter, Controlled Rectifier with Source Impedance, DC Power Supply

DC Machines Types and Related Application
DC Motor and Their Performances, Operating Modes (motoring, starting, braking), Variable Speed of DC Motor, Ward Leonard Drives, Transient Analysis

PWM Converter for DC Drives
Introduction, Switching Mode Power Supply, Continuous and Discontinuous conduction, Close-loop Control using PWM, Implementation using a Multiplier, Current Mode Control
AC to AC Conversion (AC Voltage Controller)
Principle of ON-OFF Control, Principle of Phase Control (Unidirectional and Bidirectional), Single Phase Transformer Tap Changer, Cycloconverter, AC Voltage Controller with PWM Control

AC machine types and related Applications
Three Phase Induction Motors and Their Performances, Three Phase Induction Motor Operating Modes (starting, braking), Single Phase Induction Motor, Speed Control, Synchronous Motor

Pulse-Width Modulated Inverters & Resonant Pulse Converter
Principle Operation of Single Phase Half Bridge Inverter, Single Phase Bridge Inverter, Voltage Control of Single Phase Inverter, Three Phase Inverter, 180 Degree Conduction, 120 Degree Conduction, Resonant Pulse Converters

DC Drives
Single Phase Drives (Half-wave, semiconverter, full-converter and dual-converter drives), Three-Phase Drives (Half-wave, semiconverter, full-converter and dual-converter drives), Chopper Drive of Power Control, Regenerative Brake Control, Rheostatic Brake Control and Combined Regenerative and Rheostatic Brake Control, Two Quadrant Chopper Drives, Four Quadrant Chopper Drives

AC Drives
Stator Voltage Control, Rotor Voltage Control, Frequency Control, Voltage and frequency Control, Current Control, Speed Control of Single-Phase Induction Motor, Synchronous Motor Drives

Closed-loop control
Closed-loop Control of DC Drives, Closed-loop Control of AC Drives, Digital Power Control for Power Electronic Drives

PRACTICAL: LIST OF EXPERIMENTS
1. Single-phase Semiconrolled Rectifier Application for DC Motor Drive
2. Single-phase Controlled Rectifier Application for DC Motor Load
3. Three-phase Controlled Rectifier Application for Speed Control of DC Motor
4. DC Chopper Application for DC Motor Load
5. Single-phase AC Voltage Controller Application for AC Motor Load
6. Three-phase AC Voltage Controller Application for AC Motor Load
7. Inverter Application for Single-phase AC Motor Load
8. Inverter Application for Three-phase AC Motor Load

REFERENCES
Text Book:

REFERENCES:

EET422/3 ELECTROMAGNETIC COMPATIBILITY (EMC) AND COMPLIANCE ENGINEERING

COURSE OUTCOMES
- Power Electronic Systems; Ability to explain power electronic systems operation, applications area and need for efficiency design.
- Power Semiconductor; Ability to comparative understanding of power semiconductor parameters in the design and thermal management of power electronic converters. Ability to understand power rectifier, SCR, Triac and MOSFET, gate drive requirement and circuit implementation design.
- Linear regulator and DC-DC Converter; Ability to understand, select and design around linear regulator. Ability to understand DC-DC converter as the basis of SMPS converter.
- Power processing systems; Ability to analyze and design AC-DC converter, AC-AC converter and DC-DC converter.
- Introduction to Power Quality and EMC (Line Current Harmonics); Ability to understand the design need of power quality related EMC compliance.

SYLLABUS

EMC Concepts
Basics of EMC interference types, sources and solutions: Near and far fields

EMC Directive, Standards and Routes to Compliance
Overview of EMC Directive and Standards, Generic, product specific standards and Euro-Norm standards, Technical Construction Files (TCF)

Signal Spectra
Trapezoidal waveforms

Electromagnetic Interference (EMI), Coupling and Decoupling
Inductive and Capacitive coupling, Common Impedance coupling, Crosstalk

Conducted Emissions and Test Methods
Conducted Emissions: common -mode and differential- mode, LISN, Line input filters, Testing

Radiated Emissions and Test Methods
Overview, Testing
Active and Passive Components and EMC
Modeling: Resistors, Inductors, Capacitors, Transformers, Two-Conductor and twisted, wire considerations, PCB considerations, Semiconductors and associated heatsinks

Grounding
Safety versus signal grounding, Single point versus multiple point grounding, Ground planes

Shielding
Overview, Cables and Connectors

EMC Related Directives
Safety, Low Voltage and Machinery Directives

EMC and Industrial Electronic Applications
(a selection in any one year from)
Switched Mode Power Supplies, Power Electronic Drives, Automated Systems, Information Systems, Automotive Systems

PRACTICAL: LIST OF EXPERIMENTS
Hardware
1. Lab 1 power converter line current harmonics
2. Lab 2. power supply line current harmonics
3. Lab 3. PFC SMPS Line Current Harmonics
4. Lab 4. conducted emissions testing
5. Lab 5. passive componenets & emc
6. Lab 6. emc coupling & crosstalk

Software
1. MCAD Spectral Analysis
2. MCAD Line Current Harmonics
3. MCAD Line Current Limits
4. Commercial package (to be decided)
5. Commercial package (to be decided)

REFERENCES:

EET423/4
POWER ELECTRONICS II

COURSE OUTCOMES
- Power Management Systems: Ability to identify power management systems and their application.
- SMPS Basics: Ability to identify and describe SMPS operation of basic and derived topologies. Ability to understand passive component selection of for SMPS Design.
- Power Semiconductors: Ability to understand the comparative performance, applications and selection for design of rectifier types. Ability to understand the comparative performance, applications and selection for design of power mosfets and IGBTs. Ability to demonstrate thermal management design.
- PWM Control Circuits: Ability to understand the different control strategies and modes of control for SMPS. Ability to ‘design round’ PWM controllers. Ability to analyse and design stable SMPS closed loop feedback systems.
- Analysis and Design: Ability to analyse and design (including parasitics) non-isolated converters; isolated forward converters; flyback converters and power factor corrected SMPS.

SYLLABUS

Power Management Systems and Applications
Overview of the need for and the application of power management systems

DC-DC Converters
Recap DC-DC converters

Power Semiconductors for SMPS
- P-N rectifier types, charge storage, reverse recovery characteristics and data sheet interpretation
- Schottky rectifier operation data sheet interpretation
- Power Mosfet and IGBT operation, comparative performance and data sheet interpretation

Thermal Management
Recap thermal management
Design: co-relating heat sink and power semiconductor data (fast recovery p-n and Schottky rectifiers, Mosfets and IGBT)

Switched Mode Power Supplies (SMPS):
Technology, Terminology and Specifications

SMPS Passive Component Performance and Selection
Capacitor parameters ( including parasitics) related to SMPS performance
Inductor and Transformer leakage inductance and effects

SMPS Basic Topologies
2-Basic Topology components and circuit constraints

STEP DOWN (Buck), STEP UP (Boost) and Buck-Boost) Converters
Volt-Time Integral and Power Balance Analysis
Output voltage and efficiency relationship
Continuous Current Mode (CCM) versus Discontinuous Current Mode (DCM)
CCM / DCM boundary and effect on performance
Circuit waveforms and effect of device parameters and component parasitics
Boost circuit ‘Latch-Up’

SMPS Mode of Control and Control Strategies
Voltage and Current Mode Control
Average and peak current mode control strategies
IC controllers

SMPS Controllers
Power Mosfet and IGBT gate drive requirements
Identify the functional parts of pwm ic controllers
Design: selecting the external components for ic driver to meet operational needs.
SMPS Derived Topologies
Overview of Derived Topologies

Isolated Forward and Flyback Converters
Need for Isolation. DC Transformer Concept
System Performance, Device Waveforms and
Effect of Parasitics
Transformer core reset methods.
Overlap due to leakage inductance and its
Effect on output voltage
Design: Power semiconductor device and
control ic selection versus performance
requirements

SMPS Output Filters
SMPS Output Filter: voltage ripple, transient
response and stability
Design: L-C output filter design

Feedback Loop Design for Stability
Recap Feedback Stability
Introduction to transfer function Gain and
Phase ‘K’ factor
Type 1, 2 and 3 amplifier compensation
Design: SMPS Amplifier compensation

Power Factor Corrected (PFC) Topology
Power Factor defined in relation to SMPS and
Line Current Harmonic Regulations.
PFC Boost converter operational basics
PFC ic controllers
Design: PFC circuit design

Synchronous Rectification
Synchronous rectification basics
Design: Mosfet selection for synchronous
rectifier circuits

PRACTICAL: LIST OF EXPERIMENTS
A mix of Hardware and Software experiments
+ demos selected from

Hardware
1. Lab 1. p-n Rectifier Switching Performance
2. Lab 2. Power Mosfet Switching & ic Driver Performance
5. Lab 5. Isolated Forward Converter
7. Lab 7. SMPS Stability Testing
8. Lab 8. PFC SMPS Line Current Harmonics

Software
1. MCAD Mosfet Thermal Management
2. MCAD Schottky Rectifier Thermal Management
3. MCAD Error Amplifier Compensation
4. POWER 4-5-6 SMPS simulation 5. POWER 4-5-6 SMPS simulation

REFERENCES
Text Book:

REFERENCES:

EET424/3
POWER ELECTRONICS FOR ENERGY SYSTEM

COURSE OUTCOMES
Upon successful completion of the course the students should be able to:
• Understanding of power quality terminology, problems and alternative solutions
• Knowledge of inverter topologies and comparative solutions as well as waveform shaping techniques
• Understanding UPS topologies, energy storage and applications
• Awareness of the need for sustainable energy
• Knowledge of solar energy system with power electronic applications
• Knowledge of energy audit in energy management
• Awareness of future trends in digital power electronic control of UPS system

SYLLABUS

Introduction to Power Quality
Overview of power quality, Terminology of power quality, Growing Importance, Quality versus reliability, IEEE and IEC standards, Power quality problems – disturbances and steady-state variations, Effect of power quality

Power Quality Categorization & Solutions
Voltage Quality of Voltage sag, swells, interruption and imbalance, Short circuit capacity and Severity of voltage variation, Power System Harmonic of Sources and characteristic of power system harmonic and Resonance, Measurement and solution to power quality: Types of equipment for monitoring power quality, Alternative solutions to power quality problems

Inverters
Overview of inverter, Basic inverter design, Types of inverter circuits, Single and three phase inverter, Control of output voltage, PWM Inverter: Overview of PWM inverter, Equal-pulse(uniform) PWM, Sinusoidal PWM and Control of harmonic, Voltage Source Inverter (VSI): Topology and operation of VSI and Operation, Current Source Inverter (CSI): Operation of single and three phase CSI and Application of CSI, Comparison between VSI and CSI

Uninterruptible Power Supply (UPS)
Contemporary topologies of UPS, Comparative analysis of UPS topology, Application

Power Electronics Controller for UPS System
MOSFET and IGBT Power Controller in UPS, Digital power control for UPS

Energy Storage Methodologies
Overview of storage batteries, inertial storage, fuel cell, hydrogen gas and pumped
storage, Current practice of energy storage in Malaysia, Battery: Concept of battery, Types of battery, Battery application and Environmental consideration, Fuel cell: Basic concept of fuel cell, Types of fuel cells and Fuel cell application, Economy and environmental issue related to fuel cell

**Sustainable Energy**
Overview of solar energy, biomass, biofuels and biogas, hydropower and geothermal energy, Solar applications – Current practice in Malaysia

**Energy Audit**
Overview of energy audit with relevant case study in Malaysia

**PRACTICAL: LIST OF EXPERIMENTS**
1. Power Source (Voltage) Disturbances
2. Power Line Harmonic
3. PWM Inverter Wave Shaping
4. Computer Analysis of PWM Inverter
5. Single Phase Voltage Source Inverter (VSI)
6. Three Phase Voltage Source Inverter (VSI)
7. Uninterruptible Power Supplies (UPS)
8. Solar Energy System

**REFERENCES**
Text Book:

REFERENCES:

**EET425/4**
**INDUSTRIAL ELECTRONIC CONTROL**

**COURSE OUTCOMES**
Upon successful completion of the course the students should be able to:
- Understanding of basic concept of power operational amplifiers, opto-electronic and signal processor devices and its applications
- Knowledge of industrial electronics control and its relation to industrial applications
- Good choice type of electric machines control and its applications
- Awareness of future trends in industrial electronics control

**SYLLABUS**

**Introduction to Industrial Electronic Control**
Reason For Using Industrial Automatic Control, Levels of Industrial Electronic Control Industrial Control Classification, Elements of Open and Closed Loop Systems, Feedback Control

**Interfacing Devices**
Power Operational Amplifiers, Signal Processors, Opto-electronic Interface Devices, Transducers, detection sensors and actuator, Digital to Analog Converter, Analog to Digital Converter

**The Logic and Analog Controller**
Introduction to controller, Control Modes, On/Off Controller, Proportional Controller: Proportional Integral (PI) Controller, Proportional Integral Derivative (PID) Controller, Time proportional controller, Logic Controller and Motor Speed Control Application, Closed Loop Control: On/Off Temperature Control, PWM Proportional Temperature Control, On/Off Sump Pump and Proportional Motor speed control, Proportional Motor speed control with feedback

**Servo and Stepper Motors Servo Motors:**
Introduction, DC Servo Motor, Wound Armature PM Motor, Moving Coil Motor, Brush less DC Motor, AC Servo Motor, AC Brush less Servo Motor

**Stepper Motors:**
Permanent Magnet Stepper Motor, Half Stepping, Variable Reluctance Stepper Motor, Stepper Motor Terminology, Micro stepping Limiting

**Process Control and Instrumentation Pressure Systems:**

**Temperature Control**
Thermal Control, Thermodynamic Transfer, Temperature Measurements, Temperature Indicating Devices, Electronics Sensors For Temperature Control

**Flow Control**

**Process Control Method**
Open Loop Control, Closed Loop Control, Single Variable Control Loop, Selecting a Controller, On Off control, Continuous Control

**Programmable Logic Controllers**
**Introduction to PLC:**
Industrial Motor Control Circuits, Relay Ladder Logic Circuits, Building Ladder Diagram, Motor Control Starter Circuits

**Introduction to PLC Component:**
Rack Assembly, Power Supply, PLC programming Units, Input/Output Sections, Processor Units, Addressing

**Fundamental PLC programming**
PLC program Execution, Ladder Diagram Programming language, Ladder Diagram Programming, Relay Logic Instruction, Timer Instructions, Counter Instructions

**Motion Control**
**Motion Control Feedback Devices:**
Introduction, Angular velocity Feedback devices, Angular displacement Feedback devices, Linear Displacement Feedback
devices

**Element of Motion Control:**
Introduction, Motion Control Parameters, Motion Control Elements, Operator Interface Block, Amplifier Block, Actuator Block, Feedback Transducer Block, Terminology

**Fundamental of Servomechanisms**
Introduction, Open loop and closed loop system, Closed loop velocity Servo, Bang-Bang Position Servo, Proportional Position Servo: Digital Position Servo, Characteristic of a Servomechanism, Designing Position Servo, Digital Controller, Tuning a Servomechanism and Master Slave Servo System

**PRACTICAL: LIST OF EXPERIMENTS**
1. Photo Resistor and Opto-Coupler
2. Integrator and Differential Operational Amplifier
3. Servo Motor Control
4. Stepper Motor Control
5. Hydraulic Control
6. Pneumatic Control
7. Programmable Logic Controller

**REFERENCES**
**Text Book:**

**REFERENCES:**

**EET444/6 FINAL YEAR PROJECT**

**COURSE OUTCOMES**
Upon successful completion of the course the students should be able to:
- Ability to apply theory learnt thoroughly in order to complete Final Year Project 1 & 2.
PELUANG KERJAYA

Graduan Sarjana Muda Kejuruteraan Sistem Elektrik dan Sarjana Muda Kejuruteraan Elektronik Industri mempunyai prospek kerjaya yang luas. Jurutera elektrik amat diperlukan dalam pelbagai sektor swasta atau industri, jabatan kerajaan atau badan-badan berkanun dan agensi yang berasaskan kepada rekabentuk sistem elektrik. Antara industri-industri yang memerlukan jurutera elektrik termasuklah:

- Syarikat-syarikat Multinational
- Tenaga Nasional Berhad (TNB)
- Independent Power Plant (IPP)
- Telekom Malaysia Berhad
- Angkatan Tentera Malaysia
- Jabatan Kerja Raya
- Konsultan atau kontraktor
- Pendidikan dan latihan (universiti, politeknik dan kolej)