COURSE NAME	:	AIRCRAFT STABILITY AND CONTROL *(Kawalan dan Kestabilan Pesawat)*
COURSE CODE	:	EAS3314
CREDIT	:	3(3+0)
TOTAL STUDENT LEARNING HOURS	:	120 hours
PREREQUISITE	:	EAS3313
LEARNING OUTCOMES	:	The students are able to: 1. analyze the factors associated with aircraft stability and control. (C4) 2. formulate mathematical model of aircraft dynamics for the design of automatic flight control system. (C6, CTPS) 3. differentiate aspects of aircraft stability and control, and the corresponding equations of motion. (A3, CS)
SYNOPSIS	:	This course covers an introduction to system stability, followed by static stability and control. Emphasis is given to aircraft equations of motions, longitudinal and lateral motion and automatic control theory. *(Kursus ini merangkumi pengenalan kepada kestabilan sistem, diikuti dengan kestabilan statik dan kawalan. Penekanan diberikan kepada persamaan gerakan pesawat, gerakan longitudinal dan lateral serta teori kawalan automatik).*

COURSE CONTENTS

		Contact Learning Hours
LECTURES	: 1. Introduction to system stability - Definition of stability - Static stability - Dynamic stability - Degree of stability - Method of achieving stability	3
	2. Static stability - Definition of longitudinal and lateral	6

- Contribution of aircraft components towards stability

3. Static control 6
   - Contribution of aircraft components towards longitudinal and lateral controls.

4. Aircraft equations of motion 3
   - Derivation of rigid body equations of motion
   - Position and orientation of the aircraft

5. Linearized equations of motion 3
   - Aerodynamic force
   - Moment representation.

6. Longitudinal motion 6
   - Pure pitching motion
   - Longitudinal equations of motion
   - Phugoid and short period modes
   - Longitudinal flying qualities

7. Lateral motion 6
   - Pure rolling motion
   - Pure yawing motion
   - Lateral equations of motion
   - Spiral, Roll and Dutch roll approximations
   - Lateral flying qualities
   - Aeroelastic effects

8. Linear time invariant system 3
   - State-space modelling
   - Solution of state equations

9. Automatic control theory 3
   - Controllability and observability
   - State feedback design

10. Aircraft stability augmentation 3
    - Application of modern control theory
    - Longitudinal stability augmentation
    - Lateral stability augmentation
    - Current trend flight control system

Total **42**

EVALUATION : Course Work 60%

Final Examination 40%

REFERENCES :

1. Cook, M.V. (2012). *Flight Dynamics Principles: A Linear Systems Approach to Aircraft Stability and Control (3rd Edition).* London: Butterworth-Heinemann.

2. Etkin, B. (2005). *Dynamics of Atmospheric Flight*. New York: Dover Books on Aeronautical Engineering.

3. Nelson, R.C. (1997). *Flight Stability and Automatic Control, (2nd Edition).* New York: McGraw-Hill.

4. Vepa, R. (2014). *Flight Dynamics, Simulation, and Control: For Rigid and Flexible Aircraft.* New York: CRC Press.

5. Yechout, T.R., Morris, S.L., Bossert, D.E., Hallgren, W.F. & Hall, J.K. (2014). *Introduction to Aircraft Flight Mechanics: Performance, Static Stability, Dynamic Stability, Classical Feedback Control, and State-space Foundations*. Reston, VA: AIAA Education Series.

COURSE NAME : WEB AND DATABASE
(Web dan Pangkalan Data)

COURSE CODE : ECC4207

CREDIT : 3(3+0)

SYNOPSIS : This course covers internet programming language which include Hypertext Markup Language (HTML) and cascading Style Sheet (CSS). Client-server programming techniques are also elaborated. This course also covers database concepts, relational models of database, query languages and processing. Designing and security aspects of database are also discussed.

(Kursus ini meliputi bahasa pengaturcaraan internet yang melibatkan bahasa penanda hiperteks (HTML) dan helaian gaya lata (CSS). Teknik-teknik pengaturcaraan antara pihak klien dan pelayan turut diterangkan. Kursus ini juga meliputi konsep pangkalan data, model hubungan pangkalan data, bahasa pertanyaan dan pemprosesan. Reka bentuk dan aspek keselamatan pangkalan data juga dibincangkan.)

COURSE NAME : ARTIFICIAL INTELLIGENCE
(Kecerdikan Buatan)

COURSE CODE : ECC4306

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PRE-REQUISITE : ECC3112

LEARNING OUTCOMES : Students are able to :

1. analyse the requirement of artificial intelligence method (C4)
2. evaluate system based on artificial intelligence method (C5, CTPS)
3. elaborate the fundamental and method of artificial intelligence based solutions (A4, CS, LL)

SYNOPSIS : This course covers the principles and basic theory of artificial intelligence including different methods such as fuzzy logic, neural network and genetic algorithm. It also discusses the applications of the artificial intelligence method in various fields as well as formulation of problem and assessment of artificial intelligence.

(Kursus ini meliputi prinsip dan teori asas kecerdikan buatan termasuk pelbagai kaedah seperti logik kabur (fuzzy logic), rangkaian neural dan algoritma genetik. Ia juga membincangkan aplikasi kaedah kecerdikan buatan di dalam pelbagai bidang serta penggubalan masalah dan penilaian kaedah kecerdikan buatan.)

COURSE CONTENTS

		Contact Learning Hours
LECTURE	1. Introduction to artificial intelligence - Definition - Scope - Application - Evolution - Category - Intelligence agent	3

2.	Knowledge and reasoning - The importance of knowledge representative - Logical agents - First-order logic - Inference in first-order logic	4
3.	Basics of Fuzzy systems - Introduction - Fuzzy sets - Linguistic variables	3
4.	Fuzzy expert system - Operations of Fuzzy sets - Fuzzy rules - Fuzzy inference and building a Fuzzy expert	3
5.	Machine learning - Learning from observations - Knowledge in learning - Symbol-based learning - Connectionist - Genetic and emergent - Probabilistic	6
6.	Uncertainty and Bayes network - Uncertainty - Probability reasoning system - Bayes network - Bayes using exact and estimation technique	5
7.	Basics of artificial neural networks - Concepts of neuron and brain - Types of models in neural networks	3
8.	Types of network - Multi-layer neural networks - Self-organizing neural networks	3
9.	Evolutionary computation - Introduction - Natural evolution - Genetic algorithms - Evolution strategies	6
10.	AI tools and applications	6

- Knowledge representation
- Problem formulation
- AI features and parameters
- Case studies

Total **42**

EVALUATION : Coursework 60 %
Final Examination 40 %

REFERENCES :

1. Du, K.L. and Swamy, M.N.S. *(2014). Neural Networks and Statistical Learning, London: Springer.*
2. Ertel, *W. (2011). Introduction to Artificial Intelligence, New York: Springer.*
3. *Heaton, J. (2013). Artificial Intelligence for Humans Volume 1: Fundamental Algorithms,* Chesterfield: Heaton Research Incorporation.
4. Kruse, *R.,* Borgelt, *C.,* Klawonn, *F.,* Moewes, *C.,* Steinbrecher, *M. and* Held, *P. (2013). Computational Intelligence: A Methodological Introduction, New York: Springer.*
5. *Lucci, S. and Kopec, D. (2012) Artificial Intelligence in the 21st Century, Virgina: Mercury Learning & Information.*

COURSE NAME : IMAGING SYSTEM
(Sistem Imej)

COURSE CODE : ECC4403

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PRE-REQUISITE : ECC3403

LEARNING OUTCOMES : Students are able to :

1. evaluate imaging system design (C5, CTPS)
2. select practical imaging system in solving problems based on current image processing (C4)
3. relate between basic imaging principles with digital image processing (A4, CS, LL)

SYNOPSIS : This course focuses on principles of human vision, image sensors, image displays, elements of a digital image processing system and compression used in image and video system. Digital image processing concepts in time domain and frequency domain as well as the application of digital image processing in various fields are also discussed.

(Kursus ini menekankan prinsip penglihatan manusia, penderia imej, paparan imej, elemen-elemen sistem pemprosesan imej digital dan pemampatan yang digunakan di dalam sistem imej dan video. Konsep pemprosesan imej digital dalam domain masa dan domain frekuensi serta aplikasi pemprosesan imej digital dalam pelbagai bidang juga dibincangkan.)

COURSE CONTENTS

		Contact Learning Hours
LECTURE	1. Human vision - Human vision principle - Eye and brain communication - Light, colour, saturation and brightness - Rod and cone role	3

- Contrast
- Stereoscopic vision

2. Computer vision 3
   - Photopic response
   - Brightness
   - Computer vision system
   - Difference between human and computer vision

3. Image sensor 6
   - Light and spectrum role electromagnetic in imaging system
   - Detector types
   - Video camera
   - CCD camera and CMOS
   - Focus
   - Resolution
   - Sensor advantages and weaknesses

4. Types of image display 3
   - Two dimensions for video and component not-video
   - Three dimensions for video and component not-video

5. Image display technology 3
   - Current display technology for video
   - Latest display technology
   - Advantages and disadvantages of image display technology for displaying analog and digital images

6. Basic of digital image 3
   - Objectives and applications
   - Digital image representation
   - Noise
   - Image sampling and quantization
   - Spatial resolution and brightness
   - Grey level, bit depth, pixel concept
   - Linear and nonlinear operations
   - Basic of coloured image
   - Image to video conversion

7. Digital image processing in time domain 6
   - Image enhancement
   - Histogram modification
   - Convolution
   - Smoothing

- Sharpening
- Edge detection
- Filter
- Image restoration
- Surface imaging, cross sections and three dimensions

8. Digital image processing in frequency domain 6
   - Frequency domain filter
   - Fast Fourier transform (FFT)
   - Image analysis
   - Feature extraction
   - Segmentation technique
   - Image reconstruction
   - Data compression image

9. Image and video compression 6
   - Spatial and temporal image compression
   - Encoder and decoder (CODEC) concept
   - Lossy CODEC
   - Lossless CODEC
   - Basic of MPEG CODEC
   - Image and video quality

10. Application of digital imaging system 3
    - Types of image modalities for human use : satellite images, natural images, medical images
    - Real time imaging system

Total **42**

EVALUATION : Coursework 60 %
Final Examination 40 %

REFERENCES :

1. Burger, W. & Burge, M.J. (2012). *Digital Image Processing: An Algorithmic Introduction using Java. (2nd Edition).* London: Springer.

2. Mukhopadhyay, J. (2011). *Image and Video Processing in the Compressed Domain.* Boca Raton: CRC Press.

3. Nixon, M. & Aquado, A.S. (2012). *Feature Extraction & Image Processing for Computer Vision. (3rd Edition)*. Oxford: Academic Press.

4. Russ, J.C. (2011). *The Image Processing Handbook. (6th Edition)*. Boca Raton: CRC Press.

5. Sonka, M., Hlavac, V., & Boyle. R. (2014). *Image Processing, Analysis and Machine Vision*. Stamford: Cengage Learning.

COURSE NAME : COMPUTER AND NETWORK SECURITY
(*Keselamatan Komputer dan Rangkaian)*

COURSE CODE : ECC4707

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PRE-REQUISITE : ECC3205

LEARNING OUTCOMES : Students are able to:

1. evaluate the designed of complex frameworks and networks (C5, CTPS)
2. analyse the computer and network security framework (C4)
3. describe the solution to the problem of computer and network security (A4, CS, LL)

SYNOPSIS : This course covers the topics on computer and network security, techniques of encryption and decryption. Operating system, program, network and database securities as well as advanced security techniques are also discussed.

(Kursus ini meliputi keselamatan komputer dan rangkaian, teknik-teknik penyulitan dan penyahsulitan. Keselamatan sistem pengoperasian, program, rangkaian, dan pangkalan data serta keselamatan termaju juga dibincangkan.)

COURSE CONTENTS

		Contact Learning Hours
LECTURE	1. Basic computer security - Characteristics of computer intrusion - Type of collisions - Security objectives and weakness	3
	2. Attack and defence - Type of attack - Defence method	3

- Reconnaissance and attack plans

3. Cryptography fundamental 4
   - Symmetric and asymmetric encryption
   - Mono and poly alphabetic substitution
   - Transposition
   - Characteristics of good ciphers
   - Public key systems
   - Digital signatures
   - Hash algorithms

4. Operating systems security 4
   - Methods and hidden object
   - Memory and addressing protection
   - Common object access protection
   - File protection mechanism
   - User genuinity

5. Application security 4
   - Program security
   - Virus and malicious code
   - Targeted malicious code
   - Program threats control.

6. Network security 4
   - Protocol flaws
   - Impersonation
   - Confidentiality, integrity, authentication and availability
   - Denial of services and distributed denial of services

7. Control and intrusion 5
   - Access control using honeypots, firewall, kerberos
   - Intrusion prevention system
   - Intrusion detection system
   - Intrusion tolerant system

8. Database security analysis 5
   - Threat analysis
   - Implement secure architecture that maintain integrity, auditability
   - Availability technique

9. Advanced topics 5
   - Quantum cryptography
   - Privacy

- Mobile code
- Digital rights management and copy protection
- Trusted devices

10. Case study 5
    - Network based attacks
    - Security and the law
    - Electronic voting
    - Penetration analysis
    - Ethics and full disclosure

Total **42**

EVALUATION : Coursework 60 %
Final Examination 40 %

REFERENCES :

1. Paar, C., Pelzl, J. & Preenel, B. (2011). *Understanding Cryptography: A Textbook for Students and Practitioners*. New York: Springer.

2. Rivers, C.T (2014). *Cryptography: Decoding Cryptography! From Ancient to New Age Times.* St. Louis: JR Kindle Publishing.

3. Stallings, W. & Brown, L**.** (2011). *Computer Security: Principles and Practice. (2nd Edition)*. Singapore: Pearson Education.

4. Stallings, W. (2013). *Cryptography and Network Security: Principles and Practice.* (*6th Edition*). Singapore: Prentice Hall.

5. Stallings, W. (2013). *Network Security Essentials: Applications and Standards. (5th Edition).* Upper Saddle River: Prentice Hall.

COURSE NAME	:	MATERIALS ANALYSIS *(Analisa Bahan)*
COURSE CODE	:	ECH4406
CREDITS	:	3(3+0)
TOTAL STUDENT LEARNING TIME	:	120
PREREQUISITE	:	**None**
LEARNING OUTCOMES (LO)	:	Students are able to: 1. compare the microscopic, chromatograpic and spectroscopic methods applied in materials analysis (C6) 2. integrate the theory to the techniques used for material characterization (A3, LL) 3. deduce the suitable calibration method for material analysis (C5, CTPS)
SYNOPSIS	:	This course covers the theoretical aspects and analytical techniques used for physical and chemical charaterization of material. The principles and operations of the analytical equipment, samples preparation methods and calibration procedures are also included. *(Kursus ini meliputi aspek teori dan teknik analitikal bagi pencirian fizikal dan kimia bahan. Prinsip dan operasi peralatan analitikal, kaedah penyediaan sampel dan prosedur penentukuran turut dicakupi.)*

COURSE CONTENTS			**Contact Hours**
LECTURES	1.	Introduction to material characterization - Characterization methods and type of information attained - Microscopic methods - Chromatographic methods - Spectroscopic methods - Sample preparation methods	3
	2.	Principles of microscopy - Image formation concepts - Type of lenses	3

- Image magnification
- Light spectrum, resolution, field depth, lens aberrations

3. Microscopic Instrumentation
   - Light microscope
   - Objective lense, numerical aperture, optimum image quality
   - Transmission electron microscope, electron source, electromagnetic lens, importance of vacuum
   - Scanning electron microscope, electron-atom interaction, image formation from scanning

   6

4. Principles of chromatography
   - Chromatography concepts
   - Classification of chromatographic
   - Chromatogram, ideal chromatogram
   - Gaussian peaks
   - Theoretical plate model, column efficiency

   3

5. Factors influencing separation
   - Retention parameter
   - Solutes separation
   - Peak resolution
   - Mobile phase, stationary phase, and detector

   3

6. Chromatograpic Instrumentation
   - Thin layer chromatography (TLC)
   - Gas chromatography (GC)
   - Components of GC, separation factor
   - Ion chromatography (IC), ion chromatography principle, separation principles, elution, anions, cations, and ion suppressor and conductivity detector
   - High pressure liquid chromatography (HPLC), pumps and gradient elution, principles and applications and planar chromatography technique

   6

7. Principles of spectroscopy
   - Light spectrum
   - Molecular absorption
   - Donor-acceptor associate
   - Isolated chromophore

   3

		- Effect of solvent - Quantitative analysis - Beer's-Lambert Law	
	8.	Measurement technique in spectroscopy - Visual calorimetry - Absorbance measurement - Distribution of errors - Baseline correction	3
	9.	Spectroscopic instrumentation - Ultraviolet and Visible Spectroscopy (UV / Vis-Spec) - Electron spectroscopy, X-ray photoelectron spectroscopy (XPS) and Auger Electron Spectroscopy (AES) - X-ray spectroscopy such as Energy Dispersive Spectroscopy (EDS) - Powder diffraction spectroscopy such as X-ray Diffraction (XRD) and principle of diffraction - Fourier transform infrared spectroscopy (FTIR) - Mass spectroscopy and atomic spectroscopy	6
	10.	Practical aspects of chemical analysis - Analysis of real samples - Preparing samples for analysis - Decomposing and dissolving samples	6
		Total	**42**

EVALUATION	:	Course Work	60%
		Final Examination	40%

REFERENCES :

1. Harris, D.C. (2010*). Quantitative Chemical Analysis (8th Edition)*. New York: W.H. Freeman
2. Kaufmann, E.N. (2012). *Characterization of Materials (2nd Edition)*. New York: Wiley-Interscience
3. Leng, Y. (2013). *Materials Characterization: Introduction to Microscopic and Spectroscopic Methods (2nd Edition)*. Singapore: John Wiley and Sons
4. Settle, F.A. (1997). *Handbook ofInstrumental Techniques for Analytical Chemistry*. Upper Saddle River: Prentice Hall

Sivasankar, B. (2012). *Instrumental Methods of Analysis (Oxford Higher Education)*. Oxford: Oxford University Press

SINOPSIS KURSUS

COURSE NAME	:	EMBEDDED CONTROL SYSTEM
		(Sistem Kawalan Terbenam)
COURSE CODE	:	EEE4425
CREDIT	:	3(3+0)
SYNOPSIS	:	This course covers software and hardware for embedded system. Topics discussed include real time system concept and design, and embedded system design issues.
		(Kursus ini meliputi perisian dan perkakasan bagi sistem terbenam. Topik yang dibincangkan termasuk konsep dan reka bentuk sistem masa nyata serta isu berkaitan reka bentuk sistem terbenam.)

COURSE NAME	:	MICROSYSTEM AND SENSOR
		(Mikrosistem dan Penderia)
COURSE CODE	:	EEE4225
CREDIT	:	3(3+0)
SYNOPSIS	:	This course covers categorization, design and applications of sensors. Emphases are given on the sensors, fabrication process and the design of microsystem and sensors.
		(Kursus ini meliputi pengkategorian, reka bentuk dan penggunaan penderia. Tumpuan diberikan kepada penderia, proses fabrikasi dan mereka bentuk mikrosistem dan penderia.)

COURSE NAME : HIGH VOLTAGE ENGINEERING

(Kejuruteraan Voltan Tinggi)

COURSE CODE : EEE3320

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PREREQUISITE : No prerequisite

LEARNING OUTCOMES : Students are able to:

1. explain the high voltage engineering system (C5, LL)
2. determine the insulation breakdown level for gases, solids and liquids (C5)
3. assess the types of stresses and specify the insulation system strength (A4, EM, CTPS)

SYNOPSIS : The course covers generation and measurement of high voltage, electrostatic fields and field stress control, electrical breakdown in gases, solids and liquids, non destructive insulation test techniques, overvoltages and insulation.

(Kursus ini meliputi aspek–aspek penjanaan dan penyukatan voltan tinggi, kawalan tegasan medan dan medan elektrostatik, kerosakan elektrik dalam gas, pepejal dan bendalir, teknik ujian penebat tanpa musnah, voltan lebihan dan penebatan.)

COURSE CONTENTS — **Learning Contact Hours**

LECTURE :

1. High voltage testing — 3
   - Strain voltage
   - Voltage testing
   - Power frequency
   - Lightning voltage testing
   - Switching impulse testing

2. High voltage generation — 6
   - Direct voltage
   - AC to DC converter
   - Electrostatic generator
   - AC voltage
   - Testing transformer
   - Series resonance circuits

- Impulse voltage and impulse voltage generator

3. High voltage measurement 6
   - Peak voltage measurement
   - Electrostatic voltmeter
   - Peak voltage measurement techniques
   - Voltage divider system
   - Impulse voltage measurement

4. Electrostatic and stress field 6
   - Electric field distribution and insulator material strength
   - Homogenous and multi-dielectric isotropic fields
   - Field analysis method
   - Numerical method
   - Infinite elements method

5 Electrical breakdown in gases 3
   - Gas theorem
   - Ionisation and deionisation processes
   - Cathod process
   - Change from discharge to breakdown
   - Kanal mechanisme
   - Paschen law
   - Penning effects

6. Field breakdown 3
   - Field breakdown strength
   - Breakdown in equivalent field
   - Effect of electron to breakdown criteria
   - Corona discharge
   - Polarity effect

7 Electrical breakdown in solid and liquids 3
   - Various defects in solids such as the intrinsic breakdown, electromechanical, edge, heat and corrosion.
   - Various defects in solids such as the electronic defect and hole.

8. Overvoltage 3
   - Switching overvoltage
   - Lightning overvoltage
   - Effect of overvoltage

9. Lightning 3
   - Lightning characteristics
   - Effect of lightning
   - Lightning protection
   - Lightning safety

10. Insulation coordination 6

- Type of stresses
- Insulation strength
- Insulation management

Total **42**

EVALUATION : Coursework 60%
Final Examination 40%

REFERENCES :

1. Arora, R. & Mosch, W. (2011). *High Voltage and Electrical Insulation Engineering. (1st Edition).* New York: Wiley-IEEE Press.
2. Hauschild, W. & Lemke E. (2014). *HighVoltage Test and Measuring Techniques*. Berlin: Springer.
3. Kuffel, J. & Kuffel, P. (2000). *High Voltage Engineering Fundamentals. (2nd Edition).* Oxford: Newnes.
4. Naidu, M S. & Kamaraju, V. (2013). *High Voltage Engineering*. New Delhi: McGraw Hill Education.

COURSE NAME : ELECTRICAL POWER GENERATION AND UTILISATION
(Penjanaan Dan Penggunaan Kuasa Elektrik)

COURSE CODE : EEE3327

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PREREQUISITE : No prerequisite

LEARNING OUTCOMES : Students are able to:

1. analyze and evaluate alternative techniques for power generation using renewable sources such as nuclear, solar , wind and biomass (C5, CTPS)
2. compare conventional techniques for power generation using sources such as heat , hydro , diesel and gas (A4, EM)
3. summarize energy utilization in lighting, traction, electrolytic process, and electric heating (C5)

SYNOPSIS : This course covers methods of power generation including thermal, hydro, diesel, gas and nuclear power plants. The utilisation of electrical power in lighting, electrolytic process, electrical pulling and electrical heating are discussed.

(Kursus ini meliputi kaedah penjanaan kuasa termasuk loji kuasa terma, hidro, disel, gas dan nuklear. Penggunaan kuasa elektrik dalam pencahayaan, proses elektrolitik, tarikan elektrik dan pemanasan elektrik dibincangkan.)

COURSE CONTENTS — **Learning Contact Hours**

LECTURE :

1. Introduction to power generation — 3
   - Power generation technique
   - Conventional and non-conventional technique in power generation
   - Economy in power generation.

2. Heat and hydro power plant — 3
   - Coal operation
   - Ash operation plant and mill
   - Steam generation, condenser and cooling tower
   - Contamination control

3. Hydro power plant 3
   - Types of hydro plant and consideration in design
   - Turbine classification
   - Main components
   - Mini and micro hydro plant
   - Storage pump plant
   - Environmental aspect in hydro power generation.

4. Diesel power plant 3
   - Diesel plant characteristic and layout
   - Diesel plant utilisation

5. Gas power plant 3
   - Gas plant characteristic and layout
   - Open and closed cycle plant
   - Combined cycle plant

6. Renewable and alternative energy 6
   - Nuclear fission and principles
   - Location and main components in nuclear plant
   - Reactor clssification and Control
   - Solar energy
   - Wind energy
   - Biomas energy

7. Lighting 3
   - Terms used in lighting
   - Lighting law
   - Lighting control
   - Various aspects in lighting design
   - Examples of designing different lighting
   - Electronic ballast
   - Calculation in lighting design

8. Electrolithic Process 6
   - Electrolithic principles
   - Current calculation for metal deposition
   - Metal refinement
   - Electro deposition
   - Anode plating
   - Electro polishing
   - Electro plating
   - Power supply for electrolithic process
   - Calculation examples.

9. Electrical pulling 6
   - Different systems in electrical pulling
   - Advantage, velocity-time curve
   - Mechanics in train movement
   - Pulling effort

- Specific energy utilisation
- Access electification and pulling station
- Current collector
- Negative booster
- Pulling motor control.

10. Electric heating 6
    - Heat transfer technique
    - Electric heating technique
    - Resistance heating
    - Infrared heating
    - Induction heating
    - Eddy current high frequency heating
    - Dielectric heating as well as furnace and its control.

Total **42**

EVALUATION : Coursework 60%
Final Examination 40%

REFERENCES :

1. Grigsby, L.L. (2012). *Electric Power Generation, Transmission and Distribution. (3rd Edition)*. Boca Raton: CRC Press.
2. Keljik, J. (2013). *Electricity 3: Power Generation and Delivery. (9th Edition).* New York: Delmar Cengage Learning.
3. Wadhwa, C. L. (2011). *Generation, Distribution and Utilization of Electrical Energy. (3rd Edition).* London: New Academic Science.

COURSE NAME : CONTROL SYSTEMS

(Sistem Kawalan)

COURSE CODE : EEE3421

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PREREQUISITE : ECC3121

LEARNING OUTCOMES : Students are able to:

1. formulate Laplace transform and transfer function for a given system (C5)
2. solve state space representation (C5)
3. associate time and frequency response of systems (C5, CTPS)
4. determine the stability of control systems (A4, LL).

SYNOPSIS : This course covers system modeling and analysis in time and frequency domains. Control system design is also introduced.

(Kursus ini meliputi pemodelan dan analisis sistem dalam domain masa dan frekuensi. Reka bentuk sistem kawalan turut diperkenalkan)

COURSE CONTENTS — **Learning Contact Hours**

LECTURE :

1. Introduction to control systems — 3
   - Basic concepts of control system
   - Terms in control system
   - History of control systems and mathematical relationship in control system.

2. Modelling in frequency domain — 6
   - Transfer function of electrical network and Laplace transform
   - Transfer function of translational mechanical system
   - Transfer function of rotational mechanical system
   - Transfer function of mechanical system with gears

3. Modelling in time domain — 6
   - General state-space representation
   - Applying state space representation
   - Converting transfer function to state space and vice versa.

4. Time response analysis 6
   - Poles, zeros and system response
   - First order and second order systems
   - Underdamped second order systems
   - System response with additional poles
   - System response with zeros
   - Solution of state equations using Laplace transform.
   - The effect of the PID controller on time response.

5 Reduction of multiple subsystems 3
   - Block diagrams
   - Analysis and design of feedback systems

6. Stability and Steady-State Error 3
   - Routh-Hurwitz criterion
   - Special cases and additional examples of Routh-Hurwitz criterion
   - Stability in state space

7. Steady-state error 3
   - Steady-state error for unity feedback systems
   - Static error constants and system type
   - Steady-state error specifications and for disturbance
   - Steady-state error for non-unity feedback systems

8. Root locus techniques 6
   - Defining the root locus
   - Properties of the root locus
   - Sketching the root locus
   - Refining the sketch
   - Generalised root locus
   - Root locus for positive feedback systems
   - Controller design

9. Bode plot frequency response techniques 3
   - Asymptotic approximations of Bode plots
   - Stability via the Bode plot
   - Gain margin and phase margin via Bode plots

10. Nyquist diagram frequency response technique 3
   - Nyquist criterion
   - Sketching the Nyquist diagrams
   - Stability via the Nyquist diagrams
   - Gain margin and phase margin via the Nyquist diagrams.

Total **42**

EVALUATION : Coursework 60%

Final Examination 40%

REFERENCES :

1. Dorf, R. & Bishop, H.R. (2016). *Modern Control System.(13th Edition).* Prentice Hall.
2. Franklin, G., Powell J.D. & Emami-Haeini, A. (2014). *Feedback Control of Dynamic Systems (7th Edition).* Upper Saddle River: Prentice Hall.
3. Nise, N. (2014). *Control System Engineering (7th Edition).* New York: Addison-Wesley.

COURSE NAME : MICROSYSTEM AND SENSOR
(Mikrosistem dan Penderia)

COURSE CODE : EEE4225

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOUR : 120 hours

PREREQUISITE : No prerequisite

LEARNING OUTCOMES : The student will be able to:
1. evaluate microsystem and sensor principal, applications consideration and signal condition. (C5)
2. identify fabrication process and suitable materials for microsystem and sensor. (A4, LL)
3. evaluate design and performance of the microsystem and sensor (C5, CTPS)

SYNOPSIS : This course covers categorization, design and applications of sensors. Emphases are given on the sensors, fabrication process and the design of microsystem and sensors.

(Kursus ini meliputi pengkategorian, reka bentuk dan penggunaan penderia. Tumpuan diberikan kepada penderia, proses fabrikasi dan mereka bentuk mikrosistem dan penderia.)

COURSE CONTENTS — **Learning Contact Hours**

LECTURE :

1. Microsystem and sensor fundamentals — 3
   - Microsystem and sensor technology.
   - The important and roadmap of microsystem and sensor.
   - Sensor categorization.

2. Application consideration for microsystem and sensor. — 3
   - System and sensor characteristics .
   - Selection of equipment and interfaces.
   - Measurement issues and criteria.
3. Microsystem and sensor signal conditioning — 6
   - Conditioning bridges circuits.
   - Amplifiers for signal conditioning.
   - Analog to digital converters for signal conditioning.

4. Types of sensor — 6

- Principal discussion of the following sensor with an example including fabrication and interfacing of the sensor:
  - Mechanical sensor
  - Electromagnetic sensor
  - Therma sensor
  - Optoelectronic and photonic sensor
  - Chemical and biological sensor

5. Microfabrication 3
   - Explained the need of the cleanroom.
   - Wafer level processes including chosen of material, wafer cleaning, oxidation, doping, material deposition and wafer bonding.
   - Pattern transfer and process integration including bulk machining, surface machining and mold machining.
   - Wet and dry etching used in the fabrication process.

6. Microsystem and sensor design 6
   - Microsystem and sensor design by using microelectronic technique.
   - Material selection for microsystem and sensor.
   - Mechanical and electrical analysis.

7. Microsystem and sensor fabrication 6
   - Knowing how to build a suitable fabrication flow with an example.
   - Material selection and fabrication method used such as
     - Chemical used especially during etching.
     - Material deposition technique.
     - Knowing the safety and disciplinary during fabrication.

8. Interfacing methods 3
   - Knowing the strategy to connected the microsystem/sensor and microelectronic circuit.
   - Relaibility analysis testing for the microsystem and sensor.

9. Packaging 3
   - Assembly technique including connection and wiring.
   - Packaging technique.
   - Packaging requirement such as hermetic, low parasitic reactance load and window.

10. Issues and challenges 3
    - Discussion on the issues and challenges face by microsystem and sensor.
    - Relationship between microsystem and sensor with other fields such as communication and internet.

Total		**42**

EVALUATION : Coursework 60%
Final Examination 40%

REFERENCES :

1. Fraden, J. (2016). *Handbook of Modern Sensors: Physics, Designs and Applications. (5th Edition).*New York: Springer-Verlag.
2. Jin, Y. (2010). *Introduction to Microsystem Packaging Technology*. Boca Raton: CRC Press
3. McGrath, M. (2013). *Sensor Technologies: Healthcare, Wellness and Environmental Applications. (1st Edition)*. New York: Springer-Apress open.
4. Schomburg, W.K. (2015). *Introduction toMicrosystem Design. (2nd Edition)*. Heidelberg: Springer.
5. Wilson, J.S. (2005). *Sensor TechnologyHandbook*. Boston: Elsevier-Newnes.

COURSE NAME	:	POWER SYSTEM OPERATION AND CONTROL *(Kendalian Dan Kawalan Sistem Kuasa)*
COURSE CODE	:	EEE4329
CREDIT	:	3(3+0)
TOTAL STUDENT LEARNING HOURS	:	120 hours
PREREQUISITE	:	No prerequisite
LEARNING OUTCOMES	:	Students are able to:

1. design the type of control in power system for interconnected operation and connect line (C6)
2. determine techniques for monitoring and control systems for Supervisory Control and Data Acquisition (SCADA) (C6 ,CTPS)
3. describe how electric power is generated and transferred to the power system (A4 , CTPS)
4. interpret the economical operation of the power system by taking into account the cost of permanent and also competency (A4, KK)
5. measure the power for interconnected operation(C6)

SYNOPSIS : The course covers the production and transfer of energy in power systems, flow of reactive power, and economic operation of power systems. For these, power system control methods, energy accounting on interconnected operations, communications in power systems, which include supervisory control and data acquisition (SCADA) system are discussed.

(Kursus ini meliputi penjanaan dan pemindahan tenaga dalam sistem kuasa, pengaliran kuasa reaktif, dan pengendalian berekonomi sistem kuasa. Untuk ini, kaedah kawalan sistem kuasa, perakaunan tenaga dalam pengendalian saling bersambung, perhubungan dalam sistem kuasa termasuk sistem kawalan pengawasan dan pengambilan data (SCADA) dibincangkan.)

COURSE CONTENTS		**Learning Contact Hours**
LECTURE	1. Generation and energy transfer in power system - Energy transfer - Electrical power generation - Type of generator - Loading division between generator - AC machine rotor angle	6

- Parallel operation of synchronous AC generator
- Stabilization
- Control of power flow
- Parallel operation of power system

2. Reactive power flow 6
   - Dissipation due voltage-ampere reactance (VAR)
   - Effect of line reactance to voltage monitoring
   - VAR compensation, generator and capacitor
   - SVC and STATCOM as a source for VAR
   - VAR flow due to unbalanced voltage

3. Operating cost of power system 3
   - Fixed cost
   - Variable cost
   - Efficiency of thermal power plants
   - Rate of increase
   - Economic loading for generation units
   - Effect of changes in fuel prices

4. Economical operation of power system 3
   - Nuclear
   - Geothermal
   - Solar
   - Wind
   - Coordination of hydro and thermal generation
   - Transmission dissipation
   - Economic exchange power

5. Power system control 3
   - Power system control elements
   - Frequency control
   - Automatic generation control
   - Interconnected operation

6. Type of *Tie-Line* 3
   - *Tie-Line* operating modes
   - *Tie-Line* bias
   - Reactor clssification and Control
   - Area control error
   - Accumulated frequency error

7. Energy accounting on interconnected operation 6
   - Energy measurement
   - Transformer equipment and meter rules
   - Reactance line measurement
   - Exchange negotiations
   - Interconnected energy accounting

8. Communication in power system 3

- Advancement in communication
- Voice and data communication
- Carrier system
- Multiplexing

9. Power line carrier system 3
   - Coupling of the power line to power line carrier system
   - Microwave system
   - Coaxial cable and optical fibre systems
   - Two-way mobile radio system

10. Supervisory control system and data acquisition 6
    - Control and supervision
    - Communication for SCADA system
    - Layout of SCADA system
    - Supervision of parent unit
    - Supervision of long distance unit
    - Entry control with SCADA system
    - Reliability factor of SCADA system

Total **42**

EVALUATION : Coursework 60%
Final Examination 40%

REFERENCES :

1. Allen, J. W. , Bruce, F. W. & Gerald, B. S. (2013). *Power Generation, Operation and Control. (3rd Edition)*, Hoboken: Wiley-Interscience
2. Casazza, J. & Delea, F. (2010). *Understanding Electric Power Systems: An Overview of the Technology, the Marketplace, and the Government Regulations. (2nd Edition)*. Hoboken: Wiley-IEEE Press.
3. Grigsby, L.L. (2012). *Power System Stability and Control (Electric Power Engineering Handbook)*. New York: CRC
4. Murty, P.S.R. (2011). *Operation and Control in Power Systems. (2nd Edition)*. New York: CRC Press.

COURSE NAME	:	CONTROL SYSTEM DESIGN *(Rekabentuk Sistem Kawalan)*
COURSE CODE	:	EEE4423
CREDIT	:	3(3+0)
TOTAL STUDENT LEARNING HOURS	:	120 hours
PREREQUISITE	:	No prerequisite
LEARNING OUTCOMES	:	Students are able to: 1. analyse various control systems (C5, CTPS) 2. design control system (C6) 3. determine the best control system based on the systems' characteristics (A4, LL)
SYNOPSIS	:	This course covers dynamic process and design of control system in time and frequency domains. Lyapunov stability analysis is introduced. Computer aided analysis and design are also introduced. *(Kursus ini meliputi proses dinamik dan reka bentuk sistem kawalan dalam domain masa dan frekuensi. Analisis kestabilan Lyapunov diperkenalkan. Analisis dan reka bentuk terbantu komputer juga diperkenalkan.)*

COURSE CONTENTS		**Learning Contact Hours**
LECTURE	:	
	1. Dynamic process - Mathematical modelling - Transfer function analysis - State space representation - Simulation model - Controllability and observability.	6
	2. Compensator design using time domain approach - Initial system design considerations - Lead compensation - Lag compensation - Cascade and lead-lag compensation techniques. - Operational amplifier for compensation	6

3.	Sensitivity analysis - Sensitivity in control system source - Sensitivity in parameter source	3
4	Compensator design using phase domain approach - Initial system design considerations - Lead compensation - Lag compensation - Cascade and lead-lag compensation techniques.	6
5.	Proportional integral derivative control - Tuning rules - Modification control scheme - Two degree of freedom - Robust control - Considerations on robust control design.	6
6.	Design in state-space - State feedback controller - Pole placement technique	3
7.	The design of state observer - Regulator - Reduced order design - Full order	3
8.	Non-linear system - Lyapunov function - Lyapunov stability analysis - Circle limit	3
9.	Industrial control design - Control system design through specifications - Modelling theory based on practical characteristics	3
10.	Industrial control design performance - Transient response - Stability - Performance limiting factor.	3
	Total	**42**

EVALUATION : Coursework 60%
Final Examination 40%

REFERENCES :

1. Dorf, R.C. & Bishop, R.H. (2016). *Modern Control Systems. (13th Edition)*. New York: Pearson.
2. Nise, N. (2011*). Control System Engineering. (6th Edition)*. New York: Addison-Wesley.

3. Ogata, K. (2010). *Modern Control Engineering. (5th Edition*). Upper Saddle River: Prentice Hall.
4. Poley, R. (2014). *Control Theory Fundamentals. (2nd Edition)*. Scotts Valley: CreateSpace.

COURSE NAME : INTELLIGENT CONTROL SYSTEM
(*Sistem Kawalan Pintar*)

COURSE CODE : EEE4424

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120 hours

PREREQUISITE : No prerequisite

LEARNING OUTCOMES : Students are able to:

1. analyze intelligent control system (C5, CTPS)
2. explain basic technique intelligent control (A4, LL)
3. analyze soft computing methods which use intelligent control technique mengenalpasti kaedah perkomputeran lembut yang digunakan kepada teknik kawalan pintar (C5)

SYNOPSIS : This course covers various intelligent control system algorithms. Comparison between modern and classical control is outlined. Soft-computing techniques that mimic biological systems and human reasoning are introduced.

(Kursus ini merangkumi pelbagai algoritma sistem kawalan cerdik. Perbandingan antara kawalan moden dan klasik dibincangkan. Teknik pengkomputeran lembut seakan biologi manusia dan penaakulan manusia diperkenalkan.)

COURSE CONTENTS **Learning Contact Hours**

LECTURE :

1. Comparison of control systems 3
   - Comparison between modern and classical control
   - Requirement of modern control techniques.

2. Introduction to neural network 6
   - General principle
   - Biological neuron and artifial neuron
   - Network structure
   - Activation equation
   - Learning and coding
   - Supervised learning
   - Unsupervised learning
   - Back propagation algorithm
   - Application in control

3. Application of neural networks in control system 3
   - Neural networks method in modelling
   - Neural networks method in controller

4. Introduction to fuzzy logic 6
   - General principle
   - Fuzzy variable
   - Fuzzy arithmetic and fuzzy relationship
   - Fuzzy logic principle
   - Fuzzy association
   - Fuzzy encoding
   - Fuzzy decoding
   - Fuzzy controller design

5. Application of fuzzy logic in control system 3
   - Fuzzy logic method in modelling
   - Fuzzy logic method in controller

6. Genetic algorithm 3
   - Optimization technique using genetic algorithm,
   - Implementation and analysis of canonical genetic algorithm

7. Evolution algorithm 3
   - Simple evolution algorithm
   - Evolution of fuzzy logic controller

8. DNA computing 6
   - DNA structure
   - Operations on DNA molecules
   - Array reading
   - Adleman's experiment
   - Computing paradigm.

9. Hybrid systems 6
   - Introduction to hybrid systems
   - Neuro-fuzzy system
   - ANFIS - Adaptive neuro-fuzzy system

10. Intelligent system design 3
   - Software application in intelligent system design
   - Intelligent system implementation
   - Application Development

Total **42**

EVALUATION : Coursework 60%
Final Examination 40%

REFERENCES :

1. Gupta, S. & Tushir, M. (2016). *Fuzzy Model Identification & Control of Non-Linear Systems*. New Delhi: Lambert Academic Publishing.
2. Negnevitsky, M. (2011). *Artificial Intelligence: A Guide to Intelligent Systems. (3rd Edition)*. London: Addison Wesley Ltd.
3. Ross T.J. (2010). *Fuzzy Logic with Engineering Applications. (3rd Edition)*. West Sussex: John Wiley & Sons.
4. Siddique N. & Adeli H. (2013). *Computational Intelligence: Synergies of Fuzzy Logic, Neural Networks and Evolutionary Computing*. West Sussex: John Wiley & Sons.

COURSE NAME : TRIBOLOGY
(*Tribologi*)

COURSE CODE : EMM4303

CREDIT : 3(3+0)

CONTACT HOUR : 120

PRE-REQUISIT : None

LEARNING OUTPUT : Students are able to:

1. interpret the tribology concept in the analysis of surface and measurement feature, friction, wear and Tribology characteristic (C4, CTPS)
2. explain the correct unit used in tribology (A3, CS)
3. solve industrial tribology problems to determine the friction and wear of solids, lubricant properties as well as lubrication regime and testing (A4, LL)

SYNOPSIS : This course covers the concepts and methods related to the friction, wear and lubrication. It also discusses the theory of friction, surface analysis, the properties of tribology, tribology unit, the friction of solid materials, the properties of lubricant and lubrication regime.

(*Kursus ini merangkumi konsep dan kaedah yang berkaitan dengan geseran, haus dan pelinciran. Ia juga membincangkan teori geseran, analisis permukaan, sifat tribologi, unit tribologi, geseran bahan pepejal, sifat pelincir dan rejim pelinciran*)

CONTENTS

LECTURE :

		Contact hour
1.	Development of the Industrial Tribology - Tribology in industry - Economics consideration - Solving tribology equations	3
2.	Surface measurement and its characteristic - The nature of the metal surface - Measurement of surface texture - Surface parameter - Statistical characteristic of surface	5
3.	Theory of friction - Measurement of friction - Source of friction	6

- Adhesion friction theory
- Change of plastic form of surface
- Plug effect

4. Types of wear and their mechanism 3
   - Adhesives
   - Abrasives
   - Corrosion /erosion
   - Fatigue
   - Slider fits

5. Factors affecting wears 3
   - Effect of film surface, temperature, load
   - Crystal structure and compatibility
   - Anti-wear

6. Tribology properties of solid materials 6
   - The metal tribology
   - Self-lubricating materials
   - Type of solid lubricant, graphite, molybdenum disulfide
   - The nature of plastic tribology
   - Ceramics and composites

7. Lubricating properties 3
   - Viscosity
   - Effect of temperature and pressure
   - Measurement of viscosity

8. Testing lubricants 5
   - Capillary viscometer
   - Sphere viscometer
   - Rotational viscometer
   - High pressure viscometer
   - The nature of the lubricant
   - The nature of mineral oils and additives
   - Nature of solid lubricants and greases

9. Lubrication regime 4
   - Lubrication hydrostatic
   - Lubrication border
   - Lubrication mixture
   - Hydrodynamic lubrication
   - Lubrication elasto-hydrodynamic

10.	Selection of tribology solution - Environment - Loads - Speed		4
	Total		**42**

EVALUATION : Course work : 60%
Final exam : 40%

REFERENCES :

1. Arnell, R. (2012). *Tribology: Principles and Design Applications*. Springer New york.
2. Bushan, B. (2013). Introduction to Tribology. London: John Wiley & Sons.
3. Hadfield, M. & Brebbia, C. A. (2012). *Tribology and Design II*. Southampton: WIT Press.
4. Stachowiak, G. & Batchelor, A.W. (2013). *Engineering Tribology (4th Edition)*. Oxford: Butterworth-Heinemann.
5. Menezes P.L, Nosonovsky, M. & Ingole S.P. (2013). Tribology for Scientists and Engineers., New York: Springer.

COURSE NAME	:	FINITE ELEMENT METHOD IN ENGINEERING ANALYSIS *(Kaedah Unsur Terhingga Dalam Analisis Kejuruteraan)*
COURSE CODE	:	EMM4512
CREDIT	:	3(3+0)
STUDENT LEARNING TOTAL HOURS	:	120
PREREQUISITE	:	None
LEARNING OUTCOME	:	Student able to : 1. evaluating engineering problems and use element and finite element method formulation technique (C5) 2. relate finite element method knowledge in analysing various engineering problems (C5) 3. identify finite element basis of method in engineering analysis (A4, LL)
SYNOPSIS	:	This course include analysis various problems in engineering using finite element method. It covers mathematical model, finite element method formulation, finite element of various dimensions, pre and post processing, linear structure, thermal-fluid and nonlinear structure application. *(Kursus ini merangkumi analisis permasalahan dalam kejuruteraan menggunakan kaedah unsur terhingga. Ia meliputi model matematik, perumusan kaedah unsur terhingga, unsur terhingga pelbagai dimensi, pra dan pasca pemprosesan, aplikasi struktur lelurus, terma-bendalir dan struktur tak lelurus.)*
COURSE CONTENT	:	

		Jam Pembelajaran Bersemuka
LECTURE	1. Basic concept engineering analysis and finite element method - Introduction of finite element method - Process and types of problems in engineering analysis - Steps in finite element method	3
	2. Mathematical model	3

- Vector analysis and matrix theory
- Differential equation
- Cartesian tensor

3. Finite element method formulation technique 6
   - Principle of potential energy-static
   - Elastic body potential energy
   - Rayleigh-ritz's method
   - Galerkian method
   - Balance weighted method

4. One dimension finite element 3
   - Transformation and form function
   - Elasticity matric
   - Potential energy approach and Galerkian

5. Two dimension finite element 3
   - Two dimensional boundary value problem
   - Triangular element constant strain
   - Beaming and framework

6. Isoparametrik finite element 3
   - Four node square
   - Numerical integration
   - Higher level element

7. Pre and post processing 3
   - Modelling operation
   - Meshing
   - Boundary condition
   - Results interpretation

8. Linear structural application 6
   - Static analysis
   - Thermomechanical analysis
   - Dynamic analysis

9. Fluid thermal application 6
   - Heat transfer
   - Transient flow
   - Structural fluid interaction

10. Nonlinear structural application 6
    - Geometrical nonlinearity
    - Material nonlinearity
    - Contact

	Total		**42**

ASSESSMENT : Course work 60%
Final examination 40%

REFERENCE :

1. Moaveni, S. (2014). *Finite Element Analysis: Theory and Application with ANSYS*. Essex: Pearson Education, Limited.

2. Khennane, A. (2013). *Introduction to Finite Element Analysis Using MATLAB® and Abaqus (1st edition)*. Florida: CRC Press.

3. Bryan, M. D. (2011). *Practical Stress Analysis with Finite Elements (2nd Edition)*. Dublin: Glasnevin Publishing.

4. Bathe, K. J. (2014). *Finite Element Procedures (2nd Edition)*. New Jersey: Prentice-Hall, Inc.

5. Zienkiewicz, O. C., Taylor R. L, & Zhu, J. Z. (2013). *The Finite Element Method: Its Basis and Fundamentals (7th Edition)*. Oxford: Butterworth-Heinemann.

COURSE NAME	:	ADVANCED ENGINEERING MATERIALS (*Bahan kejuruteraan Termaju*)
COURSE CODE	:	EMM4412
CREDIT	:	3(3+0)
TOTAL STUDENT LEARNING HOURS	:	120
PRASYARAT	:	None
LEARNING OUCOMES	:	Students are able to: 1. evaluate the current advanced materials in the market and its application (C5) 2. formulate the problems associated with advanced ceramic materials, advanced composite materials, electronic materials, photonics, nano-materials, bio-materials and basic materials selection (C5, TS) 3. study the basic properties of advanced materials in each category (A3, LL)
SYNOPSIS	:	This course evaluates advanced materials like ceramic, composite, electronic, nanomaterial, polymer etc that can be used in various applications such as mechanical, aerospace, manufacturing and medical. In addition, this course discusses materials selection, economic issues, environment and society in materials science and engineering *(Kursus ini merangkumi bahan termaju terkini seperti bahan seramik, komposit, elektronik, bahan nano, polimer dan sebagainya yang boleh digunakan dalam pelbagai industri seperti mekanikal, aeroangkasa, pembuatan dan perubatan. Selain itu, kursus ini juga membincangkan perkara yang berkaitan dengan pemilihan bahan dan juga isu ekonomi, alam sekitar dan masyarakat dalam sains bahan dan kejuruteraan).*
COURSE CONTENT	:	

			Contact Learning Hours
LECTURE	:	1. Introduction to advanced materials - Classificasion and functions of materials - Classification of materials based on structures - Environmental and other effects	3

2. Advanced ceramic materials 4
   - Synthesis and processing of ceramic powder
   - Unidirectional consolidation, sintering and hot press
   - Characterisation of sintered ceramics
   - Inorganic glass, glass ceramics and nanoceramic materials

3. Advanced composite materials 4
   - Introduction to composite materials
   - Particulate composite, fibre reinforced composites and laminated composites
   - Properties and characteristics of each composite
   - Ceramic matrix composites, metal matrix composites and polymer matrix composites

4. Advanced polymer materials 4
   - Structure-property relationships in thermoplastics
   - Effect of temperature on thermoplastics
   - Mechanical properties of thermoplastics
   - Polymer processing and recycling

5. Electronic materials 5
   - Introduction to electronic materials
   - Super-conductor
   - Conductor, semi-conductor dan dieletric
   - Ohm law
   - Electrical conductivity

6. Photonic materials 4
   - Electromagnetic spectrum
   - Refraction, reflection
   - Absorption and transmission
   - Selected reflection and examples of emission

7. Biomaterials 5
   - Classification of biomaterials
   - Mechanical properties of biomaterials
   - The effect of processing on properties of biomaterials
   - Tissue engineering
   - Biomaterials in medical

8. Nanomaterials 4
   - Introduction to nanomaterials

- Synthesis of nanomaterials
- Properties of nanomaterials
- Application of nanomaterials in industries

9. Materials selection and manufacturing 5
   - Procedure for material selection
   - Design process
   - Manufacturing process
   - Testing process
   - Case study

10. Economic, environment and social issues in materials science and engineering 4
    - Economic consideration in component design, materials and manufacturing techniques
    - Society and environment consideration
    - Recycling issues
    - Case study

Total **42**

EVALUATION : Course Work 60%
Final Examination 40%

REFRENCES :

1. Askeland, D.R., Fulay P.P. & Wright W.J. (2012). *The Science and Engineering of Materials SI Edition (6th Edition)*. Stamford: Cengage Learning.

2. Basu, B., Katti, D.S. & Kumar, A. (2009). *Advanced Biomaterials: Fundamentals, Processing, and Applications*. New York: Wiley.

3. Budinski, K.G. & Budinski, M.K. (2010) *Engineering Materials: Properties and Selections (9th Edition)*. New Jersey: Prentice Hall.

4. Callister, W.D. & Rethwisch, D.G. (2014). *Materials Science and Engineering SI Edition (9th Edition)*. Singapore: Wiley.

5. Gibson, R.F. (2011). *Principles of Composite Material Mechanics (3rd Edition)*. Boca Raton: CRC Press.

COURSE NAME	:	TOTAL QUALITY CONTROL (*Kawalan Kualiti Keseluruhan*)
COURSE CODE	:	EMM4607
CREDIT	:	3(3+0)
TOTAL STUDENT LEARNING HOURS	:	120
PRE-REQUISITE	:	None
LEARNING OUTCOMES	:	Students are able to: 1. differentiate production capability and product reliability (C4) 2. plan appropriate sampling for different types of production (C5) 3. identify quality problems in industry (A4, TS, LS)
SYNOPSIS	:	This course covers the concepts and methods of controlling the quality of goods, services and processes. Topics to be discussed include the quality and competitiveness, the basis of improved quality, control charts, sampling, processing, design of experiment, reliability and application of control charts. *(Kursus ini merangkumi konsep dan kaedah untuk mengawal kualiti barang, perkhidmatan dan proses. Topik yang akan dibincangkan termasuk kualiti dan daya saing, asas peningkatan kualiti, carta kawalan, persampelan, proses, reka bentuk eksperimen, kebolehpercayaan dan aplikasi carta kawalan)*
COURSE CONTENTS	:	

		Contact Learning Hours
LECTURE	: 1. Quality and competitiveness - Quality and its relationship to competitiveness - Quality and productivity - Obstacles	3
	2. Basic tools for quality improvement - Histogram, Pareto charts and flowcharts - Cause and effect diagram and scattered diagram to determine defects - Seven quality tools	3

3. Control charts of variables 3
   - Function and benefits
   - X-bar and r control chart for fixed and varied sampling sizes
   - Determination of trial center line, control limits and data distribution analysis

4. Control charts attributes 3
   - Control charts for variables and attributes
   - Control charts for np, p, c, u,
   - Corrective action for out of control charts
   - Computer usage in developing control charts attributes

5. Acceptance sampling plan 5
   - Basic concept and statistic aspect
   - Design for sampling plan
   - Lot-to-lot sampling plan for variables
   - Lot-to-lot sampling plan for attributes
   - Sampling plan for continuous and discrete production
   - Utilizing economic sampling plan

6. Process capability 5
   - Individual values compared to average
   - Population's sigma estimation from sampling
   - Control limits vs. specification limits
   - 6-sigma distribution vs. specification limits
   - Calculating process capability index

7. Design of experiment of ANOVA 4
   - One-factor ANOVA
   - Two-factors ANOVA
   - Partial factor

8. Taguchi's design 4
   - Lost function
   - Sign ratio and disorders
   - Parametric design
   - Tolerance design

9. Reliability 6
   - Basic concept
   - Reliability program
   - Product life cycle
   - Measuring reliability
   - Reliability test plan
   - Life cycle test plan

10. Applications of control charts - Control for new design - Control on techniques - Control on analysis, tolerance and inspection plan - Control for incoming materials - Tools and information for inspection - Supplier classification		6
Total		**42**

EVALUATION : Course Work 60%
Final Examination 40%

REFERENCES :

1. Aikens, H. (2011), Quality Inspired Management: the Key to Sustainability (1st Edition). Upper Saddle River: Prentice Hall.

2. Besterfield, D.H. (2014). *Quality Control (9th Edition)*. Upper Saddle River: Prentice Hall.

3. Montgomery, D.C. (2012). *Introduction to Statistical Quality Control (7th Edition)*. New York: John Wiley and Sons.

COURSE NAME	:	COMPUTER AIDED ENGINEERING DRAWING *(Lukisan Kejuruteraan Berbantu Komputer)*
COURSE CODE	:	EMM3518
CREDIT	:	3(1+2)
TOTAL STUDENT LEARNING HOURS	:	120
PREREQUISITE	:	None
LEARNING OUTCOMES	:	Students are able to: 1. interpret accurately drawings and models developed by engineers and other technologist (C3) 2. construct engineering and working drawings by utilising drawing instruments and CAD techniques according to international standards (P4, TS) 3. explain the basic concepts of engineering drawing as a communication tool to convey information and technical ideas (A3, LL)
SYNOPSIS	:	This course is an introduction to engineering drawings with greater emphasis on practicality. It includes engineering drawings using a variety of tools, techniques, sketching, geometric construction, multiview projections and auxiliary views, pictorial projections, intersection, dimensioning and tolerancing (GDT) and the working drawings in 2D and 3D using computer-aided drawing (CAD). The course also emphasizes the international standards and conventions used by engineers. *(Kursus ini merupakan pengenalan kepada lukisan kejuruteraan dengan lebih penekanan diberikan pada praktikal. Ianya merangkumi lukisan kejuruteraan menggunakan pelbagai peralatan, teknik melakar, pembinaan geometri, unjuran pandangan pelbagai dan pandangan tambahan, unjuran bergambar, persimpangan, pendimensian dan had-terimaan (GDT) dan juga lukisan kerja 2D dan 3D menggunakan lukisan berbantu komputer (CAD). Kursus ini juga menekankan piawaian dan konvensyen antarabangsa yang digunakan oleh jurutera).*

COURSE CONTENTS :

		Contact Learning Hours
LECTURE :	1. Introduction to engineering drawing and CAD - The important of drawings, standards and conventions - Traditional tools, CAD tools and future trends	1
	2. Sketching and lettering techniques - Important practices when using drawing instruments and CAD - various sketching and lettering techniques	1
	3. Geometry constructions - Draw lines, size angle, triangles, parallelograms, square, hexagon and octagon. - Divide a space, angle and lines - Construct a tangent point	2
	4. Multiview projection and auxiliary views - Standards views of an object - The concept of first-and-third angle projections. - Auxiliary view from orthographic projection	2
	5. Pictorial projections - Multiview, axonometric, oblique and perspective projections - Isometric, section views and oblique drawings	2
	6. Intersections and developments - Examples of intersections and developments - Draw and create the intersection and development	1
	7. Dimensioning and tolerancing - Standard dimensioning practices - Standard tolerance and Geometric Dimensioning and Tolerencing (GDT) symbols	1
	8. Working drawings - Define working drawings, detail drawings and assembly drawings - CAD usage for 2D and 3D working drawings - Software and hardware of CAD - Application of latest CAD system	2

9. Assembly drawings - Inclusion of components - Assembly instructions - Assembly techniques - Material schedule		1
10. Application of engineering drawings - Solution case of engineering drawings in industries		1
Total		**14**

			Contact Learning Hours
LABORATORY	:	Laboratory work will cover the drawing instruments and CAD.	
		1. Application of basic techniques of engineering drawing: Sketching and lettering techniques.	12
		2. Geometry constructions.	6
		3. Construct multiview projection.	6
		4. Construct auxiliary views.	6
		5. Construct pictorial projections (isometric drawings).	6
		6. Construct intersections and developments.	6
		7. Applications of dimensioning and tolerancing.	6
		8. Applications of CAD (2D drawings).	12
		9. Construct 3D solid modelling.	12
		10. Contruct working drawings using CAD.	12
		Total	**84**
EVALUATION	:	Course Work 100%	

REFERENCES :

1. Bertoline, G., Wiebe, E., Hartman, N., Hartman, N.W., Ross, W. & Ross W.A. (2010). *Fundamentals of Graphics Communication (6th Edition)*. Upper Saddle River: McGraw-Hill.

2. Bertoline, G., Wiebe, E., Hartman N., Ross W. (2012). *Technical Graphics Communications (4th Edition)*, Mc- Graw-Hill

3. Bethune, J.D. (2014). *Engineering Graphics with AutoCAD 2015.* New Jersey: Pearson.

4. Geisecke, F.E., Hill, I.L., Spencer, H.C., Mitchell, A.E., Dygdon, J.T., Novak, J.E., Lockhart, S.E. & Goodman, M. (2012). *Technical Drawing with Engineering Graphics (14th Edition)*. New Jersey: Pearson.

5. Goetsch, D.E., Rickman, R.L. & Chalk, W.S. (2015). *Technical Drawing for Engineering Communication (7th Edition)*. Stamford: Cengage Learning.

COURSE NAME : PRODUCTION PLANNING AND AUTOMATION SYSTEM
(*Perancangan Pengeluaran dan Sistem Automasi)*

COURSE CODE : EMM3706

CREDIT : 3(3+0)

TOTAL STUDENT LEARNING HOURS : 120

PRE-REQUISITE : None

LEARNING OUTCOMES : *Students are able to:*

1. re-arrrange forecast values using different forecasting techniques (C5)
2. develop material planning for different production quantity (C5)
3. identify techniques for production and capacity planning (A4, TS)
4. differentiate different types and application of automation in manufacturing industries (CTPS)

SYNOPSIS : This course covers the concept of production planning and automation in the industry that includes automatic machines and automated production lines. In addition, it also describes on storage system, forecasting, aggregate planning, material resource planning and capacity planning.

(*Kursus ini merangkumi konsep pengautomatan dalam industri dan perancangan pengeluaran yang merangkumi mesin automatik dan pengeluaran talian automatik. Disamping itu, ianya juga memperihalkan berkenaan sistem penyimpanan, peramalan, agregat perancangan, perancangan sumber bahan dan perancangan kapasiti.*)

COURSE CONTENTS :

		Contact Learning Hours
LECTURE	1. Introduction - Basic elements of automation - Types of automation - Manufacturing systems and plant layout - Production system and plant layout - Production concepts - Manufacturing control as a system	3
	2. Automatic machines	3

- Traditional machines and types of production machines
- Fundamental of production lines in automation
- Analysis of mass production lines
- Production rates and effiency

3. Automated production lines 6
   - Types of automated machines
   - Single and mixed model asssembly lines
   - Analysis assembly lines and prodcution rate
   - Line balancing and efficiency

4. Conventional storage system 3
   - Introduction to storage system
   - Conventional storage methods and equipment

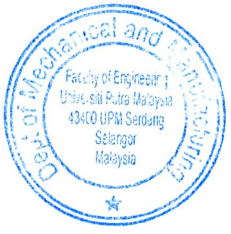
5. Storage system 3
   - Automated storage system
   - Analysis of storage system

6. Forecasting 6
   - Good characteristics of forecasting
   - Forecasting techniques
   - Forecasting error analysis
   - Forecasting evaluation

7. Aggregate planning 6
   - Definition
   - Cost element
   - Techniques for aggregate planning
   - Quantity technique
   - Heuristic technique
   - Selecting best option

8. Material resource planning 6
   - Independent and dependent product demand
   - Product tree structure
   - Bill of material
   - Inputs of material resource planning (MRP)
   - Analysis method
   - MRP outputs

9. Capacity planning 3
   - Effective capacity design
   - Capacity and strategy
   - Forecasting and meet demand
   - Understanding the technology and increasing demand
   - Finding the optimal operating limits



- Flexibility

10. Capacity development 3
    - Measuring capacity
    - Capacity planning techniques
    - Breakeven analysis for to decide capacity
    - Using a decision tree to decide capacity
    - Indefinite capacity planning

Total **42**

EVALUATION : Course Work 60%
Final Examination 40%

REFERENCES :

1. Groover, M.P. (2015). *Automation, Production Systems, and Computer Integrated Manufacturing (4th Edition)*. Upper Saddle River: Prentice Hall.

2. Heizer, J. & Render, B. (2014). *Operations Management (11th Edition)*. New York: Prentice Hall.

3. Krajewski, L.J., Ritzman, L.P. & Malhotra, M.K. (2013). *Operations Management: Process and Supply Chains (10th Edition)*. Upper Saddle River: Prentice Hall.

COURSE NAME	:	ADVANCED ENGINEERING MATERIALS (*Bahan kejuruteraan Termaju*)
COURSE CODE	:	EMM4412
CREDIT	:	3(3+0)
TOTAL STUDENT LEARNING HOURS	:	120
PRASYARAT	:	None
LEARNING OUCOMES	:	Students are able to: 1. evaluate the current advanced materials in the market and its application (C5) 2. formulate the problems associated with advanced ceramic materials, advanced composite materials, electronic materials, photonics, nano-materials, bio-materials and basic materials selection (C5, TS) 3. study the basic properties of advanced materials in each category (A3, LL)
SYNOPSIS	:	This course evaluates advanced materials like ceramic, composite, electronic, nanomaterial, polymer etc that can be used in various applications such as mechanical, aerospace, manufacturing and medical. In addition, this course discusses materials selection, economic issues, environment and society in materials science and engineering *(Kursus ini merangkumi bahan termaju terkini seperti bahan seramik, komposit, elektronik, bahan nano, polimer dan sebagainya yang boleh digunakan dalam pelbagai industri seperti mekanikal, aeroangkasa, pembuatan dan perubatan. Selain itu, kursus ini juga membincangkan perkara yang berkaitan dengan pemilihan bahan dan juga isu ekonomi, alam sekitar dan masyarakat dalam sains bahan dan kejuruteraan).*
COURSE CONTENT	:	

			Contact Learning Hours
LECTURE	:	1. Introduction to advanced materials - Classificasion and functions of materials - Classification of materials based on structures - Environmental and other effects	3

2. Advanced ceramic materials 4
   - Synthesis and processing of ceramic powder
   - Unidirectional consolidation, sintering and hot press
   - Characterisation of sintered ceramics
   - Inorganic glass, glass ceramics and nanoceramic materials

3. Advanced composite materials 4
   - Introduction to composite materials
   - Particulate composite, fibre reinforced composites and laminated composites
   - Properties and characteristics of each composite
   - Ceramic matrix composites, metal matrix composites and polymer matrix composites

4. Advanced polymer materials 4
   - Structure-property relationships in thermoplastics
   - Effect of temperature on thermoplastics
   - Mechanical properties of thermoplastics
   - Polymer processing and recycling

5. Electronic materials 5
   - Introduction to electronic materials
   - Super-conductor
   - Conductor, semi-conductor dan dieletric
   - Ohm law
   - Electrical conductivity

6. Photonic materials 4
   - Electromagnetic spectrum
   - Refraction, reflection
   - Absorption and transmission
   - Selected reflection and examples of emission

7. Biomaterials 5
   - Classification of biomaterials
   - Mechanical properties of biomaterials
   - The effect of processing on properties of biomaterials
   - Tissue engineering
   - Biomaterials in medical

8. Nanomaterials 4
   - Introduction to nanomaterials

- Synthesis of nanomaterials
- Properties of nanomaterials
- Application of nanomaterials in industries

9. Materials selection and manufacturing 5
   - Procedure for material selection
   - Design process
   - Manufacturing process
   - Testing process
   - Case study

10. Economic, environment and social issues in materials science and engineering 4
    - Economic consideration in component design, materials and manufacturing techniques
    - Society and environment consideration
    - Recycling issues
    - Case study

Total **42**

EVALUATION : Course Work 60%
Final Examination 40%

REFRENCES :

1. Askeland, D.R., Fulay P.P. & Wright W.J. (2012). *The Science and Engineering of Materials SI Edition (6th Edition).* Stamford: Cengage Learning.

2. Basu, B., Katti, D.S. & Kumar, A. (2009). *Advanced Biomaterials: Fundamentals, Processing, and Applications*. New York: Wiley.

3. Budinski, K.G. & Budinski, M.K. (2010) *Engineering Materials: Properties and Selections (9th Edition)*. New Jersey: Prentice Hall.

4. Callister, W.D. & Rethwisch, D.G. (2014). *Materials Science and Engineering SI Edition (9th Edition)*. Singapore: Wiley.

5. Gibson, R.F. (2011). *Principles of Composite Material Mechanics (3rd Edition)*. Boca Raton: CRC Press.

COURSE NAME	:	FINITE ELEMENT METHOD IN ENGINEERING ANALYSIS *(Kaedah Unsur Terhingga Dalam Analisis Kejuruteraan)*
COURSE CODE	:	EMM4512
CREDIT	:	3(3+0)
STUDENT LEARNING TOTAL HOURS	:	120
PREREQUISITE	:	None
LEARNING OUTCOME	:	Student able to : 1. evaluating engineering problems and use element and finite element method formulation technique (C5) 2. relate finite element method knowledge in analysing various engineering problems (C5) 3. identify finite element basis of method in engineering analysis (A4, LL)
SYNOPSIS	:	This course include analysis various problems in engineering using finite element method. It covers mathematical model, finite element method formulation, finite element of various dimensions, pre and post processing, linear structure, thermal-fluid and nonlinear structure application. *(Kursus ini merangkumi analisis permasalahan dalam kejuruteraan menggunakan kaedah unsur terhingga. Ia meliputi model matematik, perumusan kaedah unsur terhingga, unsur terhingga pelbagai dimensi, pra dan pasca pemprosesan, aplikasi struktur lelurus, terma-bendalir dan struktur tak lelurus.)*