NANYANG POLYTECHNIC

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DIPLOMA IN
ROBOTICS & MECHATRONICS

ADMISSION 2023

(Transmitted via Network Fax. No Signature Required)

NANYANG POLYTECHNIC

DIPLOMA IN ROBOTICS & MECHATRONICS

The Diploma in Robotics & Mechatronics provides students with a strong foundation in robotics and mechatronics technology through a well balanced theoretical and practical curriculum.

You will broaden and deepen your knowledge and skills as well as given exposure to new and emerging technology that will be relevant to the industry. There are also opportunities for local and overseas internship attachment to leading technology companies where you will pick up useful industry practices, adjacent knowledge and communications skills to further broaden your horizons.

ELECTIVE PROGRAMMES

Automation & Robotics Technology, Aerospace Technology, Biomedical Engineering, Wafer Fabrication Technology

Course Aims

The course is designed to provide graduates with:

- a strong foundation in robotics, mechanical engineering, electrical/electronic engineering and programming;
- the knowledge and skills in robotics and mechatronics principles and applications;
- excellent practical hands-on training coupled with exposure to emerging trends in robotics and mechatronics engineering and the industry with industrial attachment to leading local & overseas technology companies;

Duration: 3 academic years on a full-time basis

COURSE STRUCTURE

YEAR 1 - SEMESTERS 1 & 2

Year 1 **Please refer to Annex A for syllabus of modules.**

Core Modules		Hours
EGR150	Algebra	60
EGR151	Programming	60
EGR152	Electrical Principles	60
EGR153	Fundamentals of Mechanics	60
EGR154	Introduction to Engineering	60
EGR155	Workplace Digital Skills	30
EGR170	Calculus	60
EGR171	Fundamentals of Innovation & Enterprice	30
EGR172	Engineering Exploration Project	30
EGR173	Effective Communication Skills	30
EGR174	Engineering Drawing & Modelling	60
EGR175	Materials Technology	60
EGR176	Thermofluids	60
General Studies To complete 60 hours in life-skills related General Studies		

YEAR 2 - SEMESTERS 1 & 2

Year 2 **Please refer to Annex B for syllabus of modules.**

Core Modules		Hours
EGR201	Differential Equations & Series	60
EGR203	Electrical Machines	60
EGR204	MicroController Applications	60
EGR205	Quality Assurance	60
EGR206	Semestral Porject 4	30
EGR207	Probability & Statistics	60
EGR214	Robotics & Systems Peripherals	60
EGR215	Automatic Control	60
EGR216	Mechanical Design	60
EGR217	Device Interfacing & Programming	60
EGR218	Semstral Project 3	30
EGR221	Analogue & Digital Electronics	60
General Studies To complete 60 hours in life skills-related General Studies.		

Year 3 **Please refer to Annex C for syllabus of modules.**

Students must complete all core modules from one of the following 4 specialisation areas. They must also study a minimum of 2 prescribed electives from the respective specialisation area chosen.

Automation & Robotics Technology

Core Modules		**Hours**
EGR331	Motion Control & Drives	60
EGR332	Automation Systems Design	60
EGR303	Semestral Project 5	60
EGR351	Communication & Personal Branding	30
EGR324	Full-Time Semestral Project	12 weeks
EGR323	Industrial Attachment Programme	12 weeks
General Studies To complete 30 hours in life skills-related General Studies.		
Prescribed Electives –		Hours
EGR305	Communication & Networking	60
EGR333	Mechanism Design & Simulation	60
EGR334	Systems & Control	60
EGR310	Wafer Fabrication Processes	60

Aerospace Technology

Core Modules		**Hours**
EGR341	Aerospace Manufacturing System	60
EGR342	Aerospace Material & NDT Technology	60
EGR303	Semestral Project 5	60
EGR351	Communication & Personal Branding	30
EGR324	Full-Time Semestral Project	12 weeks
EGR323	Industrial Attachment Programme	12 weeks
General Studies To complete 30 hours in life skills-related General Studies.		
Prescribed Electives –		Hours
EGR343	Computer Aided Manufacturing/Engineering	60
EGR344	Reliability & Failure Analysis	60
EGR334	Systems & Control	60

Biomedical Engineering

Core Modules		**Hours**
EGR314	Anatomy & Physiology	60
EGR315	Biomedical Manufacturing Technology	60
EGR303	Semestral Project 5	60
EGR351	Communication & Personal Branding	30
EGR324	Full-Time Semestral Project	12 weeks
EGR323	Industrial Attachment Programme	12 weeks
General Studies To complete 30 hours in life skills-related General Studies.		
Prescribed Electives –		Hours
EGR317	Medical & Assistive Devices	60
EGR318	Biomaterials	60
EGR334	Systems & Control	60

Wafer Fabrication Technology

Core Modules		**Hours**
EGR310	Wafer Fabrication Processes	60
EGR347	Semiconductor Technology	60
EGR303	Semestral Project 5	60
EGR351	Communication & Personal Branding	30
EGR324	Full-Time Semestral Project	12 weeks
EGR323	Industrial Attachment Programme	12 weeks
General Studies To complete 30 hours in life skills-related General Studies.		
Prescribed Electives –		Hours
EGR305	Communication & Networking	60
EGR346	Vacuum Techology & RF Plasma	60
EGR334	Systems & Control	60

Annex A

Module Syllabus for Year 1

EGH150/EGF150/EGK150/EGJ150/EGM150/EGR150/EGE150/EGL150/EGD150 EGT150/EGC150 ALGEBRA

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Infocomm & Media Engineering Diploma in Advanced & Digital Manufacturing Diploma in AI & Data Engineering Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF12, EGDF13, EGDF17, EGDF19, EGDF20, EGDF21, EGDF22, EGDFPA, EGDF94		
Year:	1		
Duration / Credits:	60Hrs/4	Lecture (L): Tutorial (T): Practical (P): eLearning (E):	0 45 0 15
Pre/Corequisite:	Nil		

Synopsis

Learners will study the basic mathematical principles and tools necessary to build their engineering foundation. They will apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems. Topics covered include mathematical functions (polynomial, exponential, logarithmic, step functions and trigonometric), complex numbers, determinants, matrices and vectors.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Solve problems related to mathematical functions commonly used in engineering including polynomial, exponential, logarithmic, step functions and trigonometric by performing algebraic operations, sketching and interpreting graphs.
2. Represent and manipulate complex numbers using rectangular, polar and exponential forms.
3. Solve system of linear equations and application problems by using determinants and matrix algebra.
4. Solve problems in two-dimensional and three-dimensional spaces by applying properties of vectors and performing operations on vectors.

Topics

No.	Topic Title
1	**Matrices & Determinants**
1.1	Matrices and their Properties
1.2	Determinants of a square matrix
1.3	Inverse of Matrices
1.4	Application of Matrices and Determinants
2	**Common Engineering Functions**
2.1	Concepts of a Function, Domain and Range
2.2	Linear and Quadratic Functions
2.3	Exponential and Logarithmic Functions
2.4	Modulus and Piece-wise Continuous Functions
2.5	Unit-step Functions
3	**Basic Trigonometry**
3.1	Units for Angle Measurements
3.2	Angles
3.3	Trigonometric Functions and their Properties
3.4	Trigonometric Equations
3.5	Some Common Trigonometric Identities
3.6	Graphs of Trigonometric Functions
3.7	The R-Method
4	**Complex Numbers**
4.1	Basic Properties of Complex Numbers
4.2	Algebraic Operations of Complex Numbers in Rectangular Form
4.3	The Argand Diagram (Complex Plane)
4.4	The Polar Form of a Complex Number
4.5	The Exponential Form of a Complex Number
4.6	DeMoivre's Theorem
5	**Vectors**
5.1	Introduction to Vectors and Basic Properties
5.2	Unit Vectors and Direction of Vectors
5.3	Addition and Subtraction of Vectors
5.4	The Product of 2 Vectors

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	20	Assignment	40
ASSN2	20		
PRACX	0	Practical	0
PRESX	0	Presentation	0
PROJX	0	Project	0
TEST1	10	Test	60
TEST2	10		
TESTFA	40		

Texts & References
1. Calter, P. A., & Calter, M. A. (2011). Technical mathematics with calculus (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc
2. Hoffmann, L., Bradley, G., Sobecki, D. & Price, M. (2012). Calculus for business, economics and the social and life science (11th ed.). New York, NY: McGraw-Hill Pub.
3. Peterson, J. C. (2010). Mathematics with calculus, book 1. Singapore: Cengage Learning

EGC151 PROGRAMMING

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Advanced & Digital Manufacturing Common Engineering Programme Diploma in AI and Data Engineering		
Course Code:	EGDF09, EGDF11, EGDF12, EGDF13, EGDF17, EGDF19, EGDF20, EGDF22, EGDF94, EGDFPA		
Year:	1		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	40
		eLearning (E):	20
Pre/Corequisite:	Nil		

Synopsis

The practice-oriented module introduces learners to software development methodology. Learners will study problem-analysis and problem-solving techniques to develop essential programming skills. They will be able to create flowcharts, develop algorithms, write structured programs, test and debug programs.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Identify the program development process to solve computational problems using a programming language.
2. Use flowcharts to develop strategies and solutions to solve a problem.
3. Apply basic programming constructs using computational thinking techniques.
4. Develop structured computer programs to solve problems by applying design concepts, testing and debugging techniques.

Topics

No.	Topic Title
1	Overview of Programming
1.1	Computer Architecture and System
1.2	Software Development Life Cycle
2	Elements of a Program
2.1	Creating a Basic Program
2.2	Input and Output Functions
2.3	Concept of Variables and Data Types
2.4	Arithmetic Operators
3	Algorithm and Control Statements
3.1	Flowchart and Algorithm
3.2	Introduction to Control Statements
3.3	Selection Statement
4	User-defined Function
4.1	Function Definition
4.2	Function Calling and Argument Passing
4.3	Scoping of Function
5	Array and List
5.1	Introduction to Array / List
5.2	Declaration and manipulation of an Array / List
5.3	Multi-dimensional Array
6	File and String Operation
6.1	File Access
6.2	String Manipulation

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	10	Assignment	30
ASSN2	20		
PRACX	0	Practical	0
PRESX	0	Presentation	0
PROJ1	30	Project	30
TEST1	20	Test	40
TEST2	20		

Texts & References
1. Budd, T. (2010) Exploring Python. McGraw-Hill
2. Richard L. Halterman. (2018) Fundamentals of Python

ELECTRICAL PRINCIPLES

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Advanced & Digital Manufacturing Diploma in AI and Digital Engineering Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF12, EGDF13, EGDF17, EGDF19, EGDF20, EGDF22, EGDFPA, EGDF94		
Year:	1		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	15
		Practical (P):	24
		eLearning (E):	21
Pre/Corequisite:	Nil		

Synopsis

This module covers electrical fundamentals and their applications in electrical and electronic circuits. Topics covered include principles of electricity, power sources, resistive, capacitive and inductive circuits. Learners will apply this knowledge to analyze, interpret and solve engineering problems.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. solve engineering problems relating to electrical and electronic circuits by applying knowledge of electrical principles.
2. simplify complicated resistive network by using systematic approach of replacing series or parallel resistors by their equivalent values.
3. analyze resistive, capacitive and inductive circuits to determine various electrical parameters by applying relevant electrical laws.
4. conduct tests and measurements on circuits comprising electrical components such as resistors, inductors and capacitors using general test & measurement instruments.

Topics

No.	Topic Title
1	Electricity and Safety
1.1	Transmission of Electricity
1.2	Electrical Safety and Practices
1.3	Grounding and Circuit Protection Devices
2	Principles of Electricity
2.1	System of Units
2.2	Conductors, Insulators and Semiconductors
2.3	Electrical Charges
2.4	Electrical Potential Difference and Voltage
3	Resistive Circuits
3.1	Resistance and Conductance
3.2	Ohm's Law
3.3	Energy and Power
3.4	Kirchhoff's Voltage and Current Laws
3.5	Configurations of Resistors
4	Capacitive Circuits
4.1	Capacitance
4.2	Configurations of Capacitors
4.3	RC Circuits
5	Magnetism and Inductive Circuits
5.1	Magnetic Field and Electromagnetism
5.2	Inductance
5.3	Configurations of Inductors
5.4	RL Circuits
6	Power Sources
6.1	DC Sources
6.2	AC Sources and Transformers

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSNX	15	Assignment	15
PRAC1	20	Practical	40
PRAC2	20		
PRESX	0	Presentation	0
PROJX	0	Project	0
TEST1	15	Test	45
TESTFA	30		

Texts & References
1. Floyd, T. L. (2020). Principles of Electric Circuits : Conventional Current Version, 10th Edition. Pearson.
2. Boylestad, R. L. (2016). Introductory Circuit Analysis. Upper Saddle River: N.J. Pearson Prentice Hall.

EGC153 FUNDAMENTALS OF MECHANICS

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Advanced & Digital Manufacturing Diploma in AI & Data Engineering Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF12, EGDF13, EGDF17, EGDF19, EGDF20, EGDF22, EGDFPA, EGDF94		
Year:	1		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	30
		Practical (P):	12
		eLearning (E):	18
Pre/Co-requisite:	Nil		

Synopsis

This module provides students with the fundamentals of engineering mechanics. Topics covered include Newton laws, statics of rigid bodies, moments of inertia and bending moments. Fundamentals in dynamics that include kinematics and kinetics of particles will also be covered in this module. Students will acquire fundamental engineering competence to understand and perform engineering-related activities related to statics and dynamics.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Analyse forces and moments in static mechanical systems by using scalar / vector analyses and free body diagrams.
2. Determine the centroid and moment of inertia of composite shape by applying the parallel axis theorem.
3. Analyse the shear force and bending moment in a beam by constructing its shear force and bending moment diagrams.
4. Analyse dynamic problems in real-world situations by using Newton's laws and energy principles.

Topics

No.	Topic Title
1	**Introduction to Mechanics**
1.1	Introduction
1.2	System of Units
1.3	Scalar and Vector Quantities
2	**Forces and Laws of Motion**
2.1	Newton's Laws
2.2	Free Body Diagram
3	**Statics of Rigid Bodies in 2D**
3.1	Force System
3.2	Moment of Forces
3.3	Equilibrium of Rigid Bodies
3.4	Friction
4	**Moments of Inertia**
4.1	Centroid of an Area
4.2	Moment of Inertia
4.3	Parallel Axis Theorem
4.4	Polar Moment of Inertia
5	**Shear Force and Bending Moment**
5.1	Types of Beam Support
5.2	Types of Beam Loading
5.3	Shear Force and Shear Force Diagrams
5.4	Bending Moment and Bending Moment Diagrams
6	**Dynamics**
6.1	Kinematics: Rectilinear Motion
6.2	Kinematics: Motion of a projectile
6.3	Kinetics of particles: Newton’s law
7	**Work, Energy and Power**
7.1	Work
7.2	Energy
7.3	Power and Mechanical Efficiency

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	10	Assignment	10
PRAC1	20	Practical	30
PRAC2	10		
PRESX	0	Presentation	0
PROJX	0	Project	0
TEST1	20	Test	60
TESTFA	40		

Texts & References

1. Hibbeler, R. C. (2013). *Engineering mechanics. Statics* (13th ed, SI edition.). Singapore: Pearson.

2. Hibbeler, R.C. (2013). *Engineering mechanics. Statics and dynamics* (13th ed.). Pearson.

3. Plesha, Michael E. (2013). *Engineering mechanics. Statics* (2nd Ed). NewYork, NY: McGraw-Hill.

4. Meriam, J.L. (2013). *Engineering mechanics*. Vol 2, Dynamics. (7th Ed). Hoboken, J.J.: Wiley.

Introduction to Engineering

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Advanced & Digital Manufacturing Diploma in AI & Data Engineering Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF12, EGDF13, EGDF17, EGDF19, EGDF20, EGDF22, EGDFPA, EGDF94		
Year:	1		
Duration / Credits:	60 hrs / 4	Lecture (L): Tutorial (T): Practical (P): eLearning (E):	9 0 33 18
Pre/Corequisite:	Nil		

Synopsis

In this module, learners are exposed to different engineering disciplines by focusing on the application of relevant core engineering disciplines. Topics covered include roles and responsibilities of an engineer, ethics, and sustainability. Learners will engage in the practice of engineering through the process of conceiving, designing, and implementing solutions to engineering problems, individually and in teams. Through this, they will also be able to hone their creative thinking and problem-solving skills, build synergistic teamwork and enhance their communication skills.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Describe the roles and responsibilities of engineers by using the nature of engineering, its impact on society and environment, and practices of sustainable engineering.
2. Show understanding of various engineering disciplines through participating in multi-disciplinary engineering projects.
3. Solve engineering problems by applying multi-disciplinary engineering knowledge in programming, electrical and mechanical areas.

Topics

No.	Topic Title
1	Introduction to Engineering
1.1	Nature of Engineering and Engineering Profession
1.2	CDIO Engineering Education
2	Engineering problem solving approach and Sustainable Engineering
3	Multi-disciplinary Project Development
3.1	Project Specifications
3.2	Product Assembly & System Integration
3.3	Functional and Performance Testing

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSNX	0	Assignment	0
PRACX	0	Practical	0
PRESX	0	Presentation	0
PROJ1	20	Project	70
PROJ2	50		
TEST1	15	Test	30
TEST2	15		

Texts & References
1. Edmund Tsang. ENGR 101 Introduction to Engineering and Engineering Technology
2. Melody Morris and Janice Mathew. Introduction to Engineering. Massachusetts Institute of Technology. Retrieved from http://web.mit.edu/wi/files/WI%20presentation_MelodyJanice.pdf

Workplace Digital Skills

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Advanced & Digital Manufacturing Diploma in AI and Data Engineering Common Engineering Programme		
Course Code:	**EGH155/EGF155/EGK155/EGJ155/EGM155/ EGR155/EGE155/EGD155/EGT155/EGC155**		
Year:	1		
Duration / Credits:	30 hrs/ 2	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	22
		eLearning (E):	8
Pre/Corequisite:	No		

Synopsis

This module enables learners to use word processing software to create, modify and style document/report effectively and efficiently. Learners will use spreadsheets to manage, organise and model data as well as to perform analysis and report generation. Creation of customised, dynamic and multimedia-style presentations using software tools will also be covered. Through hands-on practices, learners will gain these skills and apply them in project work in preparation for the digital workplace.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Create documents with specifications (margins, headers, footers, use of formats and styles, etc.) and the use of the reference manager to manage the formatting of the list of references using a word processing software.

2. Create spreadsheets to perform calculations, display data, conduct analysis and generate charts and graphs using a spreadsheet software.

3. Create presentations with the use of templates and visual aids (tables, diagrams, charts, etc.) that effectively convey the content to the audience using a presentation software.

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TOPICS

No	Topic Title
1	**Word processing essentials**
1.1	Creating & editing documents
1.2	Formatting text, paragraphs, and lists
1.3	Using built-in styles to format documents
1.4	Creating custom styles
2	**Page Layout Techniques**
2.1	Working with document margins
2.2	Working with section and page breaks
2.3	Changing orientation of pages
2.4	Inserting headers and footers
3	**Working with references**
3.1	Managing table of contents
3.2	Adding and formatting endnotes and footnotes
3.3	Adding citations in documents
3.4	Creating the bibliography
3.5	Using APA style for citation and bibliography
4	**Spreadsheet processing essentials**
4.1	Entering and editing data and formulas
4.2	Working with basic spreadsheet functions
4.3	Formatting data in spreadsheets
4.4	Creating basic charts in spreadsheets
5	**Working with Spreadsheet lists**
5.1	Sorting and filtering of lists
5.2	Finding and removing duplicates
5.3	Working with list functions
5.4	Data validations
5.5	Data analysis with pivot tables
6	**Presentation slides essentials**
6.1	Professional slide structures
6.2	Formatting text
6.3	Working with graphics
6.4	Working with tables
6.5	Using slide templates

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	35	Assignment	35
PRACX	0	Practical	0
PRESX	0	Presentation	0
PROJ1	50	Project	50
TEST1	15	Test	15

Texts & References

1. Lambert, J. & Frye, C. (2018). *Microsoft Office 2019: step by step*. Pearson Education.

2. Lambert, J (2019). *Microsoft Word 2019: step by step*. Microsoft Press, U.S.

3. Frye, C. (2015). *Microsoft Excel 2016: step by step*. Microsoft Press, U.S.

4. Lambert, J (2016). *Microsoft PowerPoint 2016: step by step*. Microsoft Press, U.S.

EGH170/EGF170/EGK170/EGJ170/EGM170/EGR170/EGE170/EGD170/EGT170/ EGC170

CALCULUS

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Advanced & Digital Manufacturing Diploma in AI & Data Engineering Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF12, EGDF13, EGDF17, EGDF19, EGDF20, EGDF22, EGDFPA, EGDF94		
Year:	1		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	45
		Practical (P):	0
		eLearning (E):	15
Pre/Corequisite:	NA		

Synopsis

Through this foundation module, learners will study essential knowledge in calculus and acquire skills for solving engineering problems encountered in their course of study. Topics include differentiation and integration of commonly used functions in engineering applications.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Find the derivatives of commonly used functions in engineering by applying differentiation techniques.
2. Solve problems related to optimization, rate of change and kinematics by applying the concepts of differentiation.
3. Find the integrals of commonly used functions in engineering by applying integration techniques.
4. Solve application problems involving area under a curve, area between curves and average value of a function by applying the concepts of integration.

Topics

No.	Topic Title
1	The Derivatives
1.1	Definitions of Derivatives
1.2	Derivatives of Polynomials
1.3	Rules of Differentiation
1.4	Chain Rule
1.5	Higher Order Derivatives
1.6	Implicit Differentiation
1.7	Applications of Differentiation
1.8	Derivatives of Trigonometric and Inverse Trigonometric Functions
1.9	Derivatives of Exponential and Logarithmic Functions
2	The Integrals
2.1	Properties of Indefinite and Definite Integrals, Rules of Integration
2.2	Techniques of Integration & Integrals of Common Functions
2.3	Applications of Integration

Assessment

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	20	Assignment	40
ASSN2	20		
PRACX	0	Practical	0
PRESX	0	Presentation	0
PROJX	0	Project	0
TEST1	10	Test	60
TEST2	10		
TESTFA	40		

Texts & References
1. Calter, P. A., & Calter, M. A. (2011). *Technical mathematics with calculus.* (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc.
2. Peterson, J. C. (2010). *Mathematics with calculus, book 2.* Singapore: Cengage Learning.

FUNDAMENTALS OF INNOVATION & ENTERPRISE

Course:	NYP Diplomas		
Course Code:	-		
Year:	1		
Duration / Credits:	30 hours / 2 credits	Lecture (L):	3
		Tutorial (T):	8
		Practical (P):	14
		eLearning (E):	5
Pre/Corequisite:	NIL		

Synopsis

Learners will develop attributes that are pervasive and synonymous with being innovative and enterprising for career and life. Through this module learners will develop positive practices when working with data, propose ideas using user-centric approaches and design processes, determine and locate resources, and leverage collaborative practices to formulate solutions.

Module Learning Outcomes

At the end of this module, students will be able to:
1. organise data with consideration of the source, its validity and its relevancy;
2. describe user experiences from the user's perspective;
3. identify opportunities in relation to the user with validated assumptions;
4. plan a project schedule by considering resources and support needed;
5. co-create ideas with others by using collaboration techniques and tools.

Topics

1 **Introduction**
1.1 The I&E Journey at NYP

2 **Data**
2.1 What is 'good data'
2.2 Sources of data
2.3 Organising the data

3 **Design Processes**
3.1 Effective Empathy
3.2 Effective Definition
3.3 Ideation

4 **Resourcing**
4.1 Resources and the I&E Ecosystem
4.2 Project planning

5 **Collaboration Practice**
5.1 Communicating with others
5.2 Collaborating with others

Assessment

Assignments	20%
Practical	
Project	70%
Class Participation	
Presentation	
Quiz	10%
Test	
Examination	

Texts & References

1. Ayob, A., Hussain, A., Mustafa, M. M., & Shaarani, M. F. A. S. (2011). Nurturing creativity and innovative thinking through experiential learning. Procedia-Social and Behavioral Sciences, 18, 247-254.
2. Brown, T. (2009). *Change by design*. Haper Business.
3. Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., & Leifer, L. J. (2005). Engineering design thinking, teaching, and learning. Journal of Engineering Education, 94(1), 103-120.
4. Lewrick, M. (2018), *The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems*. Wiley.
5. Liedtka, J., King, A., & Bennett, K. (2013). *Solving problems with design thinking: Ten stories of what works*. Columbia University Press.
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7. Martin, R. L. (2009). *The design of business: Why design thinking is the next competitive advantage*. Harvard Business Press.
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EGH172/EGF172/EGJ172/EGM172/EGR172/EGD172/EGC172

ENGINEERING EXPLORATION PROJECT

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Advanced & Digital Manufacturing Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF13, EGDF17, EGDF19, EGDF22, EGDF94		
Year:	1		
Duration / Credits:	30 Hrs / 2	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	24
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

In this module, learners will be engaged in a systematic process of design thinking. Through this process, they will acquire innovative and enterprising skills to develop creative and technically robust solutions to real-world challenges.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Identify the real-world problems and challenges through brainstorming sessions and feedback from stakeholders.
2. Analyze the identified problems and challenges by using problem solving techniques.
3. Develop innovative and enterprising solutions through idea pitching using graphical visualization or quick prototypes.

Topics

1 Project Launch
1.1 Project Scope and Desired Outcome
1.2 Project Planning

2 Project Preparation
2.1 Discover Engineering
2.2 Case Study on Machine Mechanisms

3 Project Development
3.1 Prototype Development
3.2 Prototype Testing and Iteration

4 Project Closure
4.1 Project Documentation & Presentation

Assessment

Assignments	30%
Practical	
Project	50%
Class Participation	
Presentation	
Quiz	20%
Test	
Examination	

Texts & References

1. Dym, C. L., Little, P., & Orwin, E. J. (2014). *Engineering design: a project-based introduction* (4th ed.). New York: Wiley.
2. Cross, N. (2008). *Engineering design methods: strategies for product design* (4th ed.). Chichester, England: John Wiley.
3. Budynas, R., & Nisbett, K. (2006). *Shigley's Mechanical Engineering Design* (8th ed.). McGraw-Hill Science/Engineering/Math.

EFFECTIVE COMMUNICATION SKILLS

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical and Aerospace Technology Diploma in Aerospace Systems and Management Diploma in Nanotechnology and Materials Science Diploma in Engineering with Business Diploma in Robotics and Mechatronics Diploma in Electronic and Computer Engineering Diploma in Infocomm and Media Engineering Diploma in Advanced and Digital Manufacturing Common Engineering Programme		
Course Code:	EGDF09 / BME EGDF11 / AAT EGDF12 / ASM EGDF13 / NMS EGDF17 / EB EGDF19 / RM EGDF20 / ECE EGDF21 / IME EGDF22 / ADM EGDF94 / CEP		
Year:	1		
Duration / Credits:	30 Hrs / 2	Lecture (L):	0
		Tutorial (T):	24
		Practical (P):	0
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

Communicating well is a vital life skill, benefitting all aspects of our lives from professional life to social gatherings. It is thus important to be proficient in both written and oral communication. This module will enable learners to communicate effectively in different settings and on different collaborative platforms. There will be opportunities to practise and deliver various types of presentations, competently handle questions, and effectively incorporate verbal and non-verbal elements when speaking. Learners will also acquire media and information literacy and be able to produce clearly written and well-structured reports and proposals, following standard citation and referencing guidelines.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Apply interpersonal communication strategies with consideration of purpose, audience, and settings.
2. Demonstrate effective oral presentation skills by considering content, organisation, delivery strategies and language.
3. Produce clearly written reports and proposals by considering good structure, language and supporting graphical illustrations.
4. Display understanding of ethics in writing by avoiding plagiarism and following standard citation and referencing guidelines.
5. Validate information sources by applying principles of information literacy.

Topics

1 **Communication Process and Strategies**
1.1 Definition of Communication
1.2 Characteristics of Communication
1.3 The Communication Model
1.4 Factors Affecting Communication
1.5 Interpersonal Communication
1.6 Gathering Information
1.7 Engaging in Self-Disclosure
1.8 Responding to Criticism
1.9 Managing Conflict

2 **Oral Presentation Skills**
2.1 Definition of a Presentation
2.2 Types of Presentations
2.3 Steps to a Successful Presentation
2.4 Definition of a Team
2.5 Developing Effective Team Presentations
2.6 Delivering Effective Team Presentations

3 **Report and Proposal Writing**
3.1 Definition of a Report
3.2 Characteristics of Effective Reports
3.3 Varieties of Reports
3.4 Planning the Report
3.5 Conducting Surveys
3.6 Writing the Report
3.7 Illustrating the Report
3.8 Definition of a Proposal
3.9 Types of Proposals
3.10 Proposal Writing Tips
3.11 Structure of Proposals

4 **Info-Literacy and Research Referencing**
4.1 Definition of Information Literacy
4.2 Research Referencing
4.3 Definition of Media Literacy
4.4 Fake News
4.5 Evaluating Sources

Assessment

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1 ASSN2	25% 50%	Assignment	75%
PRACX	0%	Practical	0%
PRES1	25%	Presentation	25%
PROJX	0%	Project	0%
TESTX	0%	Test	0%

Texts & References

- Adler, R & Elmhorst, J. (2010). *Communicating at Work: Principles and Practices for Business and the Professions*. 10th Edition. New York, NY: McGraw-Hill.
- Beebe, S, Beebe, S J, & Ivy, D. (2013). *Communication: Principles for a Lifetime*. 5th Edition. Upper Saddle River, NJ: Pearson.
- Campbell, M. (2002). *Bullet Proof Presentations*. Newburyport, MA: Weiser.
- Hamilton, C & Creel, B. (2011). *Communicating for Success*. New Jersey, NJ: Pearson.
- Kuiper, S & Clippinger, D. (2012). *Contemporary Business Report Writing*. 4th Edition. Mason, OH: South-Western.
- Locker, K & Kienzler, D. (2010). *Business and Administrative Communication*. 9th Edition. New York, NY: McGraw-Hill.
- Thill, J & Bovée, C. (2011). *Excellence in Business Communications*. 9th Edition. Upper Saddle River, NJ: Pearson.
- Online Resources:
  https://www.skillsyouneed.com/present/presentation-tips.html
  https://www.skillsyouneed.com/present/what-is-a-presentation.html
  http://totalcommunicator.com/vol3_1/expert2.html
  http://www.businessdictionary.com/definition/proposal.html
  http://www.cws.illinois.edu/workshop/writers/tips/proposal/

EGH174/EGF174/EGJ174/EGM174/EGR174/EGD174/EGC174

ENGINEERING DRAWING & MODELLING

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Advanced & Digital Manufacturing Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF13, EGDF17, EGDF19, EGDF22, EGDF94		
Year:	1		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	50
		eLearning (E):	10
Pre/Corequisite:	NIL		

Synopsis

In this module, learners will gain knowledge and skills to model the engineering parts and interpret drawings that are derived from the 3D models. Topics covered include orthographic projection, sectional views, assembly drawing, geometric dimensioning and tolerancing**.** Learners will acquire necessary skills in communicating ideas and concepts through engineering drawings, which is one of the necessary and critical skills needed in the design process.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Interpret the engineering drawings and standard symbols used by generating 3D models from 2D drawings.
2. Construct 3D models and their corresponding detail drawings using CAD software.
3. Create assembly drawing and the bill of materials using the CAD software.

Topics

1 Introduction
1.1 Engineering Drawing and Computer Aided Design (CAD)

2 Technical Drawing
2.1 Drawing Standards
2.2 Orthographic Projection
2.3 Isometric View
2.4 Sectional View

3 Solid Modelling
3.1 File Management
3.2 Sketch Commands
3.3 Feature Commands

4 Detail Drawing
4.1 Drawing Sheets, Title Block and Layout
4.2 Dimensioning
4.3 Drawing Annotation
4.4 Geometric Dimensioning & Tolerancing (GD&T)

5 Assembly in Solid Modelling
5.1 Assembly Unit

6 Assembly Drawing
6.1 Assembly Layout
6.2 Bill of Materials
6.3 Ballooning

Assessment

Assignments	35%
Practical	50%
Project	
Class Participation	
Presentation	
Quiz	15%
Test	
Examination	

Texts & References

1. David L. Goetsch, William S. Chalk, John A. Nelson, Raymond L. Rickman. (2005). *Technical Drawing* (5th ed.). Thomson Delmar Learning.

2. Smith, D., & Ramirez, A. (2011). *Technical drawing 101: a multidisciplinary curriculum for the first semester* (2nd ed.). Upper Saddle River, N.J.: Pearson Prentice Hall.

3. James D. Meadows. (1995). *Geometric Dimensioning and Tolerancing*. Marcel Dekker.

EGH175/EGF175/EGJ175/EGM175/EGR175/EGD175/EGC175

MATERIALS TECHNOLOGY

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Advanced & Digital Manufacturing Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF13, EGDF17, EGDF19, EGDF22, EGDF94		
Year:	1		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	15
		Practical (P):	15
		eLearning (E):	30
Pre/Corequisite:	Nil		

Synopsis

In this module, students will acquire knowledge of properties and applications of engineering materials, including ferrous and non-ferrous metals, polymers, composites, and ceramics. Learners are exposed to various material properties tests and characterization, material processing methods and different material failure modes. Learners will be able to select appropriate materials for specific engineering applications.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Explain important properties of engineering materials by discussing the relevant parameters to measure these properties and their influencing factors.
2. Explain various types of processing, characterization and failure modes for commonly used engineering materials.
3. Apply knowledge of commonly used engineering materials and properties by selecting appropriate materials for a specific engineering application.

Topics

1 Engineering Materials and Properties
1.1 Types of engineering materials
1.2 Introduction to atomic structure
1.3 Basic structure and bonding of materials
1.4 Properties of materials
1.5 Mechanical properties

2 Ferrous and Non-ferrous Metals
2.1 Structure of metals
2.2 Constitution of steel
2.3 Properties & applications of steels
2.4 Overview of non-ferrous metals and applications
2.5 Introduction to heat treatment

3 Polymers
3.1 Overview of polymers
3.2 Molecular structures and properties of polymers
3.3 Additives to polymers
3.4 Common polymers and applications
3.5 Processing of Polymers

4 Ceramics
4.1 Overview of ceramics
4.2 General properties and application of ceramics
4.3 Processing of ceramics

5 Composites
5.1 Overview of composites
5.2 General properties and applications of composites
5.3 Processing of composites

6 Failure of Materials
6.1 Corrosion
6.2 Fatigue
6.3 Creep

Assessment

Assignments	15%
Practical	45%
Project	
Class Participation	
Presentation	
Quiz	10%
Test	
Examination	30%

Texts & References

1. Srinivasan, R. (2010). *Engineering Materials and Metallurgy*. (2nd ed.). New Delhi: Tatas McGraw Hill Education.
2. Callister, W. D. & Rethwisch, D. G. (2010). *Materials Science & Engineering-An Introduction*. (8th ed.). Hoboken, NJ: John Wiley & Sons.

THERMOFLUIDS

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Advanced & Digital Manufacturing Common Engineering Programme		
Course Code:	EGDF09, EGDF11, EGDF13, EGDF17, EGDF19, EGDF22, EGDF94		
Year:	1		
Duration / Credits:	60 Hrs/4	Lecture (L): Tutorial (T): Practical (P): eLearning (E):	0 30 15 15
Pre/Corequisite:	NIL		

Synopsis

This module introduces the concepts of heat, fundamentals of thermodynamics, and fluid mechanics. Topics covered include temperature, heat capacities, latent heat, heat transfer, the ideal gas law, the first law of thermodynamics, properties of fluids, and concepts and basic equations of fluid statics and fluid flow. Learners will apply their knowledge to analyse and solve problems relating to heat, heat transfer, ideal gases, fluid statics and fluids in motion.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Analyze pressures and forces in a system of fluids at rest using fluid statics equations and the concept of density.
2. Determine dynamic fluid properties along a streamline using the general energy equation.
3. Analyze heat transfer by identifying applicable modes and using thermal properties of materials.
4. Solve thermodynamics problems using the laws of thermodynamics, ideal gas laws and properties of pure substances.

Topics

No.	Topic Title
1	Fluid Statics
1.1	The characteristics & properties of fluids
1.2	Pressure in fluids
1.3	Atmospheric pressure
1.4	Absolute pressure, gauge pressure & pressure of vacuum
1.5	Measurement of pressure
1.6	Fluid pressure on a submerged surface
2	Fluids in Motion
2.1	Flow characteristics & important properties
2.2	Conservation of mass
2.3	Conservation of energy
2.4	Flow measurement
2.5	Friction & minor losses in pipes
3	Temperature and Basic Heat Transfer
3.1	Kinetic model of matter (temperature)
3.2	Temperature
3.3	Heat transfer processes, modes & equations
3.4	Conservation of energy
4	Thermodynamics & Ideal Gases
4.1	Specific heat capacity
4.2	Latent heat
4.3	Work, heat and energy
4.4	Introduction to thermodynamics systems and their applications
4.5	The first law of thermodynamics
4.6	Ideal gas

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	10	Assignment	10
PRAC1	15	Practical	30
PRAC2	15		
PRESX	0	Presentation	0
PROJX	0	Project	0
TEST1	20	Test	60
TESTFA	40		

Texts & References
1. Borgnakke & Sonntag. (2019). *Fundamentals of Thermodynamics* (10th ed.). John Wiley & Sons.
2. Massey, B.S. (2011). *Mechanics of Fluids* (9th ed.). Taylor and Francis.
3. Iynkaran. (1994). *Basics Thermodynamic*s. Prentice Hall.
4. John & Haberman. (2015). *Engineering Thermodynamics with Heat Transfer* (2nd ed.). Pearson India.

Annex B

Module Syllabus for Year 2

EGR201
DIFFERENTIAL EQUATIONS & SERIES

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	20
		Tutorial (T):	22
		Practical (P):	0
		eLearning (E):	18
Pre/Corequisite:	Equivalent of Year 1 Mathematics		

Synopsis

This module provides learners with the knowledge of solving ordinary differential equations and representing periodic functions in terms of Fourier series. The learners will be able to select and use appropriate models and techniques to solve engineering related problems. The main topics covered include first-order and second-order homogenous differential equations, Fourier series and its application.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Find the solutions of ordinary differential equations which describe the behaviour of physical systems.
2. Solve initial-value problems using the techniques of Laplace transform.
3. Represent periodic functions using Fourier series.
4. Analyse signals using the amplitude and phase spectrums.

Topics

1 Differential Equations
1.1 Integration by Parts
1.2 Partial Derivatives
1.3 First Order Differential Equations
1.4 Second Order Differential Equations
1.5 Engineering Applications of Differential Equations

2 Fourier Series
2.1 Sequences and Series
2.2 Fourier Series
2.3 Amplitude Spectrum

3 Laplace Transform
3.1 Laplace Transform for Standard Functions
3.2 Theorems on Laplace Transform
3.3 Inverse Laplace Transform
3.4 Solutions of Differential Equations
3.5 Further Laplace Transform

Assignments	40%
Practical	
Project	
Class Participation	
Presentation	
Quiz	20%
Test	
Examination	40%

Texts & References

1. Smith, R. T, & Minton R. B. (2012). *Calculus: Early transcendental functions (Int'l Ed)* (4th ed.). New York, NY: McGraw-Hill Higher Education.

2. Stewart, J. (2010). *Calculus (concepts and contexts).* Singapore: Cengage Learning.

3. Zill, D. G. (2010). *Engineering mathematics (differential equations and Laplace transform).* Singapore: Cengage Learning.

EGR203 Electrical Machines

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	18
		Tutorial (T):	14
		Practical (P):	16
		eLearning (E):	12
Pre/Corequisite:	Electrical Principles & Circuit		

Synopsis

This module provides students with essential knowledge of direct current (DC) and alternating current (AC) electrical machines, machine characteristics, performance features, control and protection circuits. Major topics cover electro-mechanical principles, rotating machines, transformer, DC motor, AC motors (1-phase and 3-phase). The use of control and protection circuits for different motor applications would be emphasised in laboratory practical. This module provides a foundation for power electronic, motion control and automation control technology.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Apply the knowledge of direct current (DC) and alternating current (AC)
2. Apply the working knowledge, techniques and skills in electrical machinery to use them in practical applications.
3. Apply the working knowledge, techniques and skills in electrical machinery to use them in practical applications.

Topics

1 Fundamental of Electrical Machines
- 1.1 Introduction
- 1.2 Electrical Circuits
- 1.3 Magnetic Circuits
- 1.4 Electromagnetic Induction

2 Principles of DC Machines
- 2.1 Operating Principles of DC Motor
- 2.2 Types and Applications of DC Motors
- 2.3 Shunt DC Motor
- 2.4 Starting of DC Motor
- 2.5 Series DC Motor
- 2.6 Speed control for DC Motor
- 2.7 Speed Regulation, Motor Efficiency and Power Losses

3 Single-Phase and Three-Phase Circuit
- 3.1 Alternating Current
- 3.2 Single-Phase Circuit
- 3.3 Three-Phase Circuit
- 3.4 Star-Delta Load
- 3.5 Three phase Power Measurement

4 Transformers
- 4.1 Introduction
- 4.2 Principles of a Single-Phase Transformer
- 4.3 Equivalent Circuit of a Transformer
- 4.4 Voltage Regulation and Transformer Efficiency
- 4.5 Open-Circuit and Short-Circuit Tests

5 Induction Motor
- 5.1 Construction and Operating Principles
- 5.2 Power Flow Calculations for three phase Induction Motor
- 5.3 Three phase Induction Motor Equivalent Circuit
- 5.4 Three phase Induction Motor Characteristics
- 5.5 Single-Phase Induction Motor

Assessment

Assignments	25%
Practical	25 %
Project	15%
Class Participation	10 %
Presentation	-
Quiz	25%
Test	
Examination	

Texts & References

1. Theraja, B. L., and A. K. Theraja. *A textbook of electrical technology: in S.I. system of units*. 24th ed., 1st multicoloured ed. New Delhi: S. Chand and Co., 2005. Print.
2. Pillai, S. K.. A first course on electrical drives. 2nd ed. New York: Wiley, 1989. Print.
3. Ryff, Peter F.. Electric machinery. Englewood Cliffs, N.J.: Prentice-Hall, 1988. Print.

EGR204 Micro-controller Applications

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR204		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	11
		Tutorial (T):	11
		Practical (P):	20
		eLearning (E):	18
Pre/Corequisite:	Computer programming		

Synopsis

This module introduces the application design and development process for an embedded microcontroller system. Students will learn to develop microcontroller application programmes. Concepts covered in microcontroller programming are I/O programming, peripherals programming and interrupt handlings. Case studies will be used to illustrate the fundamental building blocks of a microcontroller system and how they are inter-related. Upon completion of this module, students will be able to demonstrate the use of various basic programming skills and knowledge on an embedded microcontroller system.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Develop embedded system software using modern tools which interfaces with timers, interrupt and external hardware using general purpose input and output.
2. Recognise a microcontroller based system and explain how each component work within.
3. Analyse and solve real world problems using case studies.

Topics

1 Introduction to Microcontroller applications and History of Microprocessor

1.1 Introduction
1.2 Evolution of the Microprocessors
1.3 Moore's Law

2 The Microcomputer System

2.1 Basic Component of a Microcomputer System
2.2 Input/Output Devices
2.3 Program Memory
2.4 Microprocessor
2.5 Data Memory
2.6 The Development Process

3 The 8051 Microcontroller

3.1 Using I/O Ports
3.2 Storage of Program
3.3 Internal Peripherals
3.4 The 8051 Families of Microcontroller

4 Output Interfacing

4.1 Basic output interfacing circuitry and programming
4.2 Interfacing with multiplexed display
4.3 Interfacing with other output devices

5 Input Interfacing

5.1 Basic input interfacing circuitry and programming
5.2 Interfacing with numeric keyboard
5.3 Interfacing with other input devices

6 Timer

6.1 Basic Concept of the Timer Peripheral
6.2 Programming the Timer

7 Interrupt

7.1 Basic Concept of Interrupts
7.2 Sources of Interrupt
7.3 Interrupt Programming

Assessments

Assignments	
Practical	40%
Project	
Class Participation	20%
Presentation	
Quiz	20%
Test	20%
Examination	

Texts & References

1. The 8051 Microcontroller and Embedded Systems using Assembly and C Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay Pearson International
2. C and the 8051: Hardware, Modular Programming and Multitasking. Volume 1 Tom Schultz, Prentice Hall PTR

EGR205 QUALITY ASSURANCE

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	21 (+9E)
		Tutorial (T):	13 (+2E)
		Practical (P):	8 (+7E)
		eLearning (E):	18
Pre/Corequisite:	NA (Prerequisite)		

Synopsis

This module aims to provide students with the fundamental principles in dimensional measurement and quality assurance systems. Topics covered include selection and proper use of precision measuring tools and equipment, which is the basis of inspection and quality control, and basic statistical concepts such as sampling plans, control charts and process capability studies. Hands-on practice using measurement tools, including those with digitizing capabilities, is an integral part of the module. Upon completion of the module, the students will be able to perform measuring tasks effectively and understand how measurement data can be digitally processed and employed in data analytics for the monitoring of modern manufacturing systems.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Explain fundamental quality concepts in a manufacturing environment.

2. Perform measurement and inspections of work-pieces using various measuring instruments, by applying fundamental concepts in dimensional measurement.

3. Perform process monitoring and control by applying basic statistical tools such as process control charts, capability process studies and acceptance sampling plans

Topics

1	**Basic Concepts of Quality**
1.1	The concepts of quality, Quality Control & quality responsibility
1.2	Quality Assurance
1.3	Importance of inspection
2	**Linear Measuring Instruments**
2.1	Classification of instruments
2.2	Selection of instruments

2.3 Factors affecting accuracy of a Measuring System
2.4 Proper techniques in handling Tools and Equipment

3 Optical Inspection
3.1 Working Principle of Optical Profile Projector
3.2 Applications of Profile Projectors
3.3 Advantages of using an Optical Profile Projector

4 Basic Statistical Methods
4.1 Population and Sample
4.2 Data Characteristics
4.3 Continuous Probability Distribution
4.4 Discrete Probability Distribution

5 Statistical Process Control
5.1 Variable Control Charts
5.2 Attribute Control Charts
5.3 Process Capability Studies

6 Acceptance Sampling
6.1 Fundamental sampling concepts
6.2 Acceptance Sampling Plans
6.3 Operating Characteristic Curve

Assessment

Assignments	
Practical	30%
Project	
Class Participation	10%
Presentation	
Quiz	30%
Test	30%
Examination	

Texts & References

1. “Quality Control”, Dale H. Besterfield.
2. “Introduction to Statistical Quality Control”, Douglas C. Montgomery.
3. “Principles of Quality Control”, Jerry Banks.
4. ”Statistical Quality Control”, Eugene L. Grant, Richard S. Leavenworth.
5. ”Metrology for Engineers”, J.F W. Galyer, C.R. Shotbolt.

EGR206 Semestral Project 4

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	30 Hrs / 2	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	27
		eLearning (E):	3
Pre/Corequisite:	Nil		

Synopsis

This module enables students to develop their skills in single board computer/micro-controller programming and applications in a mechatronics environment. Students will learn to interface various input and output devices through a series of practical exercises. Using the programming skills that they have learnt earlier. Students will develop code to drive external devices such as motors, LEDs and sensors. In addition, this module emphases the use of technology to troubleshoot and innovate. In all, students will have gained an overview of a mechatronics system and the design/development process involved.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Identify basic input, output ports of a micro-controller/micro-processor, and explain their applications.
2. Create programs to read sensor's status.
3. Create programs to control actuator.
4. Publish information to LCD.
5. Implement a controller that reads input from sensor and moves actuator according to a set of requirements.

Topics

1 Introduction
1.1 Laboratory safety and tools
1.2 Software development environment

2 Digital Output
2.1 Introduction
2.2 Interfacing circuit
2.3 Output commands

3 Digital Input

3.1 Introduction
3.2 Interfacing circuit
3.3 Input commands

4 Display Module
4.1 Introduction to Liquid Crystal Display (LCD)
4.2 Interfacing circuit and programming commands

5 Sensor
5.1 Introduction to sensors
5.2 Interfacing circuit

6 PWM Output
6.1 Introduction
6.2 PWM commands and Application

7 Project
7.1 Mini Project

Assessment

Assignments	80%
Practical	
Project	
Class Participation	5%
Presentation	
Quiz	
Test	15%
Examination	

Texts & References

1. Bradbury, A. (2014). *Learning Python with Raspberry Pi.*
2. Monk, S. (2013). *Programming the Raspberry Pi : getting started with Python.* New York: McGraw-Hill.

EGH207/EGD207/EGF207/EG2916/EGJ207/EG1761/EG2961/EGM207/ EG2008/EGR207
Probability & Statistics

Course:	Diploma in Biomedical Engineering Diploma in Digital & Precision Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Multimedia & Infocomm Technology Diploma in Electrical Engineering with Eco-Design Diploma in Engineering with Business Diploma in Electronic Systems Diploma in Robotics & Mechatronics		
Course Code:	EGDF09, EGDF10, EGDF11, EGDF12, EGDF13, EGDF15, EGDF16, EGDF17, EGDF18, EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	22
		Tutorial (T):	20
		Practical (P):	0
		eLearning (E):	18
Pre/Corequisite:	Equivalent of Year 1 Mathematics		

Synopsis

This module provides learners with the essential concepts of probability and statistics. The learners will be able to apply probability theory and statistics to analyse real life problems. The topics covered include the probability concepts, probability distributions (Binomial, Poisson and Normal), sampling distributions, estimating and testing of population mean, linear correlation and regression.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Analyse data and relationships using central tendency, variability, scatterplot, linear correlation and regression.
2. Conduct data analysis and interpretation using appropriate probability distributions.
3. Estimate an unknown population mean of a given probability distribution by constructing a confidence interval.
4. Evaluate the statistical significance of a hypothesis for a given set of data using the *z*-test or *t*-test.

Topics

1 Fundamental Statistics
1.1 Descriptive Statistics
1.2 Scatter Diagram and Correlation
1.3 Simple Linear Regression

2 Probability
2.1 Counting Principles
2.2 Basic Probability Concepts

3 Probability Distributions
3.1 Discrete Random Variable
3.2 Binomial and Poisson Distributions
3.3 Normal Distribution
3.4 Sampling Distribution and the Central Limit Theorem

4 Population Parameter
4.1 Estimate of the Population Mean
4.2 The *t* - Distribution
4.3 Introduction to Hypothesis Testing
4.4 Testing Population Means

Assessment

Assignments	30%
Practical	0%
Project	0%
Class Participation	0%
Presentation	0%
Quiz	20%
Test	0%
Examination	50%

Texts & References

1. Cheng, A., & Gupta, M. (Eds.). (2010). *Engineering mathematics – series and statistics.* Singapore: Pearson Custom Publishing.

2. James, G. (2006). *Engineering mathematics.* Upper Saddle River, NJ: Pearson, Prentice Hall.

3. Johnson, R. A., Miller, I., Freund, J., Johnson, R. A., & Freund, J. E. (2010). *Probability and statistics for engineers* (8th ed.). Upper Saddle River, NJ: Prentice Hall.

EGR214 Robotic Systems & Peripherals

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	30
		Tutorial (T):	0
		Practical (P):	30
		eLearning (E):	3
Pre/Corequisite:	Nil		

Synopsis

This module is designed to provide the students with a sound knowledge of robotics technology. The module covers robot classification and anatomy, robot kinematics, control concept, robotic communication and programming, system peripherals, machine vision system and robotic safety. Upon completion of this module, the students are able to gain a basic understanding of the key aspects of robotics.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Apply the knowledge of integrated robotics technology in the field of flexible automation.
2. Define and analyse the dexterous motions of a robotics system for various type of robotics systems.
3. Apply the knowledge on the highly multidisciplinary fields of robotics systems for various industrial applications.

Topics

1 Introduction to Robotics
1.1 Terms and Terminology
1.2 Classification of Robotics
1.3 Robotics Anatomy

2 Control of Actuators in Robotic Mechanisms
2.1 Servo Control
2.2 Open Loop Control
2.3 Control Components

3 Robotics Programming
3.1 On-line Programming Methods
3.2 Simulation and Off-line Programming

4 End Effector
4.1 Classification of End Effector
4.2 Design Considerations

5 Robotic Communication
5.1 Serial and Parallel Date Communication
5.2 Networking

6 Robotic Vision System
6.1 Fundamentals o Machine Vision
6.2 Image Representation and Processing
6.3 Applications

7 Robot Safety
7.1 Human Considerations
7.2 Prevention Measures
7.3 Three Levels of Safety Monitoring

8 Robotic Applications
8.1 Material Handling
8.2 Processing Operations
8.3 Assembly and Inspection

9 Kinematics and Kinetics
9.1 Robot Kinematics
9.2 Kinetics of Robot Arm – Force & Acceleration

Assessment

Assignments	
Practical	40%
Project	
Class Participation	
Presentation	
Quiz	30%
Test	30%
Examination	

Texts & References

1. Mc Donald, A. C., “Robot Technology: theory, design and applications”, Prentice Hall
2. Koren, Y., “Robotics for Engineers”, Mc Graw Hill
3. Klafter, R. D., “Robotic Engineering – An Integrated Approach”, Prentice Hall
4. Spong, M. W., “Robot Dynamics and Control”, John Wiley & Sons

EGR215 Automatic Control

Course:	Diploma in Robotics and Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	12
		Tutorial (T):	12
		Practical (P):	24
		eLearning (E):	12
Pre/Corequisite:	NIL (Prerequisite)		

Synopsis

This module equips students with the knowledge of pneumatics, electro-pneumatic control, Programmable Logic Controller (PLC) and its applications. Students will learn to design basic pneumatics and electro-pneumatic circuits and develop PLC ladder programs using IEC61131-3 programming standard. Students. Students will also learn combinational and sequential logic control techniques to design an automation system.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Understand the principles of pneumatic and electro-pneumatic control through applying the knowledge of pneumatic and electro-pneumatic peripherals and sensors in an automatic control system.
2. Design and troubleshoot electro-pneumatic control circuits for automatic control systems by acquiring the proficiency of designing and simulating the control circuits using software simulation tool.
3. Design and develop ladder logic program of programmable logic controller to control the industrial automation equipment or system

Topics

1 **Introduction to Basic Control System**
1.1 Basic elements of a control system
1.2 Types of drive and control media

2 **Pneumatics, Electro-mechanical Elements & Sensors**
2.1 Compressed air system
2.2 Pneumatic actuators
2.3 Pneumatic Control Valves & Accessories
2.4 Sizing of Cylinders
2.5 Electro-Mechanical Devices
2.6 Safety and circuit protection devices
2.7 Sensors

3 **Electro-Pneumatic Circuit Design**
3.1 Basic Electro-Pneumatic Circuit Design
3.2 Circuit design using cascade method

4 **Programmable Logic Controller (PLC)**
4.1 Industrial Automation Controller
4.2 PLC Architecture and Operating Principles
4.3 Introduction to PLC Standard IEC 61131-3 Programming
4.4 Building Blocks of IEC 61131-3

5 **PLC Programming**
5.1 PLC Program
5.2 PLC Basic Function and Operation
5.3 Application Program Development

6 **Graphical Flow Charting using GRAFCET**
6.1 Converting GRAFCET to Ladder Diagram (LD)
6.2 IEC 61131-3 Sequential Function Chart (SFC)

Assessment

Assignments	
Practical	40%
Project	
Class Participation	
Presentation	
Quiz	30%
Test	30%
Examination	

Texts & References

1. Industrial Automation, John Wiley & sons, David W. Pessen
2. Programmable logic controllers: Principle & Application, Prentice Hall, Ian G. Warnock
3. IEC 1131-3: programming industrial automation systems : concepts and programming languages, requirements for programming systems, aids to decision-making tools, Karl-Heinz John, Michael Tiegelkamp, Springer

EGR216 MECHANICAL DESIGN

Course:	Diploma in Robotics and Mechatronics		
Course Code:	EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	15
		Tutorial (T):	14
		Practical (P):	24
		eLearning (E):	7
Pre/Corequisite:	Engineering Drawing & modelling		

Synopsis

This module covers the strength of materials and its application to machine elements and engineering design. It provides students with the fundamental knowledge in engineering design. This includes stress analysis, limits and fits, sizing of drive elements such as shaft, gear, flexible drive and leadscrew, and the application of bearings. Design exercises are included to provide the students with hands-on experience in design. At the end of this module, they will be able to effectively contribute to the design of mechanisms.

Module Learning Outcomes

At the end of this module, students will be able to:

1. determine the limits of fit and size of shaft/hole based on the various loading conditions.
2. calculate the critical parameters of the various drive mechanisms (gear, belt, chain and leadscrew) used in a simple machine.
3. determine the maximum stress and factor of safety for combined stresses using Mohr's circle and failure theories (max shear stress, distortion energy and normal stress).
4. design a mechanism using top down and bottom up approach with a CAD software.
5. achieve the creation of engineering drawings such as assembly drawing, part list and part drawing of a mechanism.

Topics

1 **Introduction**
1.1 Design process

2 **Limits and Fits**
2.1 Tolerance
2.2 Fits
2.3 Stack up tolerance

3 **Shafts and bearings**
3.1 Shafts
3.2 Bearings

4 **Drive elements**
4.1 Gear
4.2 Belt drive
4.3 Chain drive
4.4 Leadscrew

5 **Combined stresses**
5.1 Stresses on element
5.2 Mohr's circle

6 **Design for Static Strength**
6.1 Factor of safety
6.2 Failure modes

7 **Design using CAD**
7.1 Shaft design
7.2 Threaded and clearance holes
7.3 Assembly of components
7.4 Engineering drawings

Assessment

Assignments	
Practical	30%
Project	
Class Participation	
Presentation	
Quiz	15%
Test	15%
Examination	40%

Texts & References

1. Robert L. Mott, P.E. Machine elements in mechanical design.
   Pearson Prentice Hall
2. Joseph E, Shigley, Charles R, Mischke. Mechanical engineering design.
   McGraw-Hill

EGR217 Device Interfacing & Programming

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR217		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	14
		Tutorial (T):	10
		Practical (P):	30
		eLearning (E):	6
Pre/Corequisite:	EGR109 Analogue & Digital Electronics		

Synopsis

This module introduces students to sensors and actuators, which are commonly used in mechatronic systems, and the interfacing techniques used for connecting them to a microprocessor/computer. Hands-on applications of these devices will also be provided. Upon completion of the module, students will be able to demonstrate the techniques and skill used to integrate devices in realising a mechatronic system.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Identify the commonly used sensors and actuators and discuss their working principle, characteristics and applications.
2. Explain interfacing circuits for sensors and actuators.
3. Recognise modern devices and demonstrates their usage in a computer based control system.

Topics

1 Introduction
1.1 Introduction to device interfacing & programming
1.2 Overview of computer based control system
1.3 Sensors and actuators

2 Sensor Characteristics
2.1 Sensor Range/Accuracy/Sensitivity
2.2 Sensor Linearity/Hysteresis/Repeatability

3 Sensors
3.1 Position sensor
3.2 Optical encoder
3.3 Proximity sensor

3.4 Temperature sensor
3.5 Force/Pressure sensor
3.6 Vision sensor

4 Interfacing
4.1 Input/output interfacing
4.2 Output interfacing
4.3 Output – Digital & Output- Analog

5 Analog-to-Digital Conversion
5.1 Analog signal & Digital signal
5.2 Analog to digital conversion
5.3 ADC timing
5.4 Types of ADC converter

6 Types of Communications
6.1 Transmission mode
6.2 Asynchronous transmission
6.3 Serial communication
6.4 Network topology
6.5 Wireless

Assessment

Assignments	
Practical	30%
Project	
Class Participation	10%
Presentation	
Quiz	30%
Test	30%
Examination	

Texts & References

1. Graham Dixey, Computer Interfacing
2. Peter Juliff, Program Design
3. William Stallings, Data and Computer Communications
4. LabVIEW 7 Express Student Edition, Robert Bishop, Prentice Hall
5. Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering, W. Bolton, Prentice Hall

EGR218 – SEMESTRAL PROJECT 3

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR218		
Year:	2		
Duration / Credits:	30 Hrs / 2	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	20
		eLearning (E):	10
Pre/Corequisite:	NIL		

Synopsis

This module aims to develop students' innovative and enterprising mindset by providing them with experiences in self-initiated learning in innovation and enterprise. Students will learn to recognise and relate the importance of innovation and enterprise through studying real-world examples around them, as well as a series of experiential exploration and research into varied technologies, products and industries.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Recognise the importance of innovation and enterprise by relating to real-world examples around them.
2. Demonstrate innovative and enterprising mindset by describing their experiences, relating ideas and expressing opinion through written, oral and graphical communication.
3. Contribute effectively as a team member, with effectiveness being determined by instructor observations, peer ratings, and self-assessment.

Topics

1 Introduction

2 Innovative and Enterprising Mindset
2.1 Innovation in Everyday Life
2.2 Industry Discovery
2.3 Understanding Success Factors in Product Innovation

3 Idea Exploration and Development
3.1 Idea Exploration
3.2 Idea Development

Assessment	
Assignments	30%
Practical	-
Project	-
Class Participation	20%
Presentation	50%
Quiz	-
Test	-
Examination	-

Texts & References

1. Kendall, D., Cole, T., Ducharme, D. (Feb 2007). Criteria Evaluation Matrix. Retrieved from https://henderson.ces.ncsu.edu/files/library/88/Criteria%20Evaluation%20Matrix.doc

2. Osterwalder, A., Pigneur, Y., Bernarda, G., Papadakos, T., and Smith, A. (2014) Value Proposition Design: How to Create Products and Services Customers Want. New York, USA: Wiley.

EGF221/EGR221 ANALOGUE & DIGITAL ELECTRONICS

Course:	Diploma in Aeronautical & Aerospace Technology Diploma in Robotics & Mechatronics		
Course Code:	EGDF11 / EGDF19		
Year:	2		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	14
		Practical (P):	28
		eLearning (E):	18
Pre/Corequisite:	Nil		

Synopsis

This module covers various analogue and digital devices, such as diodes, bipolar junction transistors, operational amplifiers, and basic logic gates. The working principles, designs, and applications of these devices in electronic circuits are also covered. This module provides the foundation for advanced electronic modules in electronic engineering courses

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Identify the structures and explain the characteristics of electronics devices such as diodes, special purpose diodes, bipolar junction transistors, and operational amplifiers used in electronic circuits.
2. Analyse the operation of diodes, special purpose diodes, bipolar junction transistors, and operational amplifiers used in common electronic applications.
3. Recognise the symbols used for basic logic gates and describe their operations with truth tables and Boolean expressions.
4. Acquire the essential knowledge and techniques in digital electronics for analysing and designing basic logic circuits.
5. Conduct tests and measurements on electronic circuits comprising logic gates, diodes, special purpose diodes, transistors and operational amplifiers.

Topics

No.	Topic Title
1	**Fundamental of Analogue and Digital Electronics**
1.1	Introduction to the module
1.2	Electrical Quantities
1.3	Kirchoff Voltage and Current Law
1.4	Voltage Divider Rule
2	**PN Junction and Diodes**
2.1	Semiconductor Theory
2.2	Characteristics & parameters of diodes
2.3	Forward and Reverse Biasing of diodes
2.4	Series and Parallel connection of diodes
2.5	Half Wave and Full Wave Rectifier
3	**Other Two Terminal devices**
3.1	Zener Diodes
3.2	Voltage Regulator using Zener Diode
3.3	Light-Emitting diodes
3.4	Photo diodes
4	**Transistors**
4.1	Basic BJT Structures
4.2	BJT Symbols
4.3	Basic BJT configurations and V-I characteristics
4.4	Operating Characteristics of a BJT
4.5	Basic BJT Equations
4.6	Transistor Biasing Circuits
5	**Operational Amplifier (Op-Amp)**
5.1	Ideal Op-Amp
5.2	Practical Op-Amp
6	**Linear Op-Amp Circuits**
6.1	Introduction to Op-Amp
6.2	Inverting Amplifier
6.3	Non Inverting Amplifier
6.4	Voltage Buffer
6.5	Summing Amplifier
7	**Number Systems**
7.1	Decimal Number System
7.2	Binary Number System
7.3	Hexadecimal Number System

8	**Combinational Logic**
8.1	Basic Logic Functions
8.2	Boolean Algebra
8.3	Logic Simplification
8.4	Karnaugh Maps
8.5	Implementation of Logic Circuits from Logic Equation
9	**Sequential Logic**
9.1	Flip flop
9.2	Counters

Task	**Task Weighting (%)**	**Method**	**Method Weighting (%)**
ASSNX	0	Assignment	0
PRAC1	15	Practical	30
PRAC2	15		
PRESX	0	Presentation	0
PROJ1	30	Project	30
TEST1	20	Test	40
TEST2	20		

Texts & References

1. Boylestad, R. L. & Nashelsky, L. (2012). *Electronic devices and circuit theory* (11th ed.). Upper Saddle River, NJ: Prentice Hall.
2. Floyd, T. L. (2017). *Electronic devices (Conventional Current Version)* (10th ed.). Upper Saddle River, NJ: Prentice Hall.
3. Robert T. Paynter (2013). *Introductory electronics devices and circuits (Electron flow version)*, (7th Edition), Pearson Prentice Hall.
4. Thomas L. Floyd (2015). *Digital Fundamentals*, (10th edition), Pearson Prentice Hall

Annex C

Module Syllabus for Year 3

EGR303 Semestral Project 5

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	15
		Tutorial (T):	12
		Practical (P):	15
		eLearning (E):	18
Pre/Corequisite:	Nil (Prerequisite)		

Synopsis

This module develops students' abilities in applying techniques, skills and knowledge learnt for new product design, development and product marketing. Students are expected to present their solutions with a complete business plan, which includes but not restricted to information gathering, market analysis, manufacturability, product usability, robustness of design and cost analysis. Upon completion of the module, students will be able to demonstrate an understanding of the processes involved in new product design/development, cost analysis and product marketing.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Describe the techniques and skills learnt in product design, development and product marketing based on design thinking approach.

2. Identify the technopreneurial skills needed in the areas of organizational structure, marketing, development, financing and cost analysis by working as a team with different business roles.

3. Outline a business plan summary based on a technology venture.

Topics

1. Design Process
   - 1.1 Introduction
   - 1.2 What is design?
   - 1.3 What is design process?
   - 1.4 Example of activities in design process

2. Product Life-Cycle
   - 2.1 Product development

- 2.2 Introduction
- 2.3 Growth
- 2.4 Maturity
- 2.5 Saturation
- 2.6 Decline
- 2.7 Extending the product life-cycle

3. Technopreneurship
   - 3.1 Definition of entrepreneur
   - 3.2 Definition of technopreneur

4. Forms of Business Ownership
   - 4.1 Ways to start business
   - 4.2 Types of business arrangements
   - 4.3 Characteristics of the legal forms of business

5. Market Research
   - 5.1 What is a target market?
   - 5.2 Market research
   - 5.3 Classification of data
   - 5.4 Types of data
   - 5.5 Understand the competition

6. Registering Your Business
   - 6.1 What's in a name?
   - 6.2 Guidelines for choosing a name
   - 6.3 Establishing a mission statement
   - 6.4 Company objectives

7. Government Assistance
   - 7.1 SME masterplan
   - 7.2 Government assistance schemes
   - 7.3 Why is government assistance needed?

8. Feasibility Study
   - 8.1 What is SWOT analysis?

9. Financial Planning Before Starting in a Business
   - 9.1 Preparing financial statements
   - 9.2 Breakeven analysis
   - 9.3 Perform breakeven analysis

10. Marketing Plan
    - 10.1 Marketing mix
    - 10.2 Write your marketing plan

11. Financial Plan
    - 11.1 Income statement
    - 11.2 Sales/Revenue/Turnover
    - 11.3 Expenses
    - 11.4 The matching principle
    - 11.5 Introduction to balance sheet
    - 11.6 Assets = Liabilities + Capital
    - 11.7 Ratio analysis

12. Develop a Business Plan
    - 12.1 The Business plan
    - 12.2 Outline for a business plan
    - 12.3 10 reasons business plan fails at first glance
    - 12.4 Questions every investor will ask

Assessment

Assignments	50%
Practical	
Project	50%
Class Participation	
Presentation	
Quiz	
Test	
Examination	

Texts & References

1. Creative design of mechanical devices. Hong-Sen Yan. Singapore; New York: Springer. C1998

2. Entrepreneurship: Ideas in Action, Cynthia L. Greene Mason, Ohio: Thomson, South
3. Western, C2004. 2nd Edition

4. The mechanical design process, David G. Ullman. McGraw-Hill. 4th Edition. Entrepreneurship: Strategies and Resources. Marc J. Dollinger. Upper Saddle River, N.J: Prentice Hall, C2003. 3rd Edition.

COMMUNICATION & PERSONAL BRANDING

Course:	Diploma in Biomedical Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Aerospace Systems & Management Diploma in Nanotechnology & Materials Science Diploma in Engineering with Business Diploma in Robotics & Mechatronics Diploma in Electronic & Computer Engineering Diploma in Infocomm & Media Engineering Diploma in Advanced & Digital Manufacturing		
Course Code:	EGDF09/EGDF11/EGDF12/EGDF13/EGDF17/EGDF19/EGDF20/ EGDF21/EGDF22		
Year:	3		
Duration / Credits:	30 Hrs / 2	Lecture (L):	0
		Tutorial (T):	24
		Practical (P):	0
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

In today's competitive environment, a strong personal brand sets one apart from others. In this module, learners will develop techniques to impress and persuade others to accept their ideas. They will also learn how to communicate effectively over email. To support their job search, learners will use digital portfolios to showcase their abilities, as well as gain the knowledge and skills to promote their capabilities in their cover letters and resumes. They will also acquire skills to project themselves positively and for performing well at interviews.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Develop a communication pitch to persuade others to be receptive of one's ideas at meetings and discussions.
2. Write clear and concise emails that follow workplace conventions.
3. Write cover letters and resumes that highlight value-add.
4. Develop an online identity and a digital portfolio to showcase personal abilities for supporting job applications.
5. Portray a positive image at interviews to persuade employers of their suitability.

Topics

1 **Pitching Your Ideas**
- 1.1 Pitching Fundamentals
- 1.2 Planning Your Pitch
- 1.3 Doing Up Your Pitch Deck
- 1.4 Delivering Your Pitch

2 **Email Etiquette and Writing**
- 2.1 Introduction to Emails
- 2.2 Email Etiquette
- 2.3 Writing Effective Emails

3 **Cover Letter and Resume**
- 3.1 Introduction to Cover Letters and Resumes
- 3.2 Organising and Styling
- 3.3 Writing Cover Letters and Resumes Effectively

4 **Creating Your Digital Portfolio**
- 4.1 Introduction to Portfolios
- 4.2 Setting Up Your Digital Portfolio
- 4.3 Your Digital Portfolio Content
- 4.4 Optimising Your Digital Portfolio

5 **Performing at Interviews**
- 5.1 Purpose of Interviews
- 5.2 Preparing for Interviews
- 5.3 At the Interview
- 5.4 Other Types of Interviews

6 **Projecting a Positive and Professional Image**
- 6.1 Making a Positive First Impression
- 6.2 Establishing Your Professional Image
- 6.3 Communicating Impactfully
- 6.4 Applying Professional Business Etiquette

7 **Building Your Online Brand**
- 7.1 Establishing Your Online Brand Strategy
- 7.2 Taking Your Brand Online
- 7.3 Growing Your Online Brand

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSN1	30	Assignment	60
ASSN2	30		
PRACX	0	Practical	0
PRES1	40	Presentation	40
PROJX	0	Project	0
TESTX	0	Test	0

Texts & References

- Brown, Rob. (2016). *Build Your Reputation*. Cornwall: John Wiley & Sons, Inc.
- Gratton, Sarah-Jayne. (2012). *Follow Me! Creating A Personal Brand.* Indianopolis: John Wiley & Sons, Inc.
- Kearn, David. (2010). *Pitching To Win*. London: Marshall Cavendish Business.
- Li Kin, Pang. (2010). *Professional Image: Your Roadmap To Success*. Singapore: Marshall Cavendish Business.
- Schepp, Brad and Schepp, Debra. (2012). *How To Find A Job On LinkedIn, Facebook, Twitter and Google+*. 2nd Edition. USA: McGraw-Hill.
- Soorjoo, Martin. (2012). *Here's The Pitch.* New Jersey: John Wiley & Sons, Inc.
- Taylor, Fig. (2012). *How To Create A Portfolio & Get Hired.* 2nd Edition. London: Laurence King Publishing.
- Van Geel, Jeroen. (2018). *Pitching Ideas.* Revised. Amsterdam: BIS Publishers.
- Online resources:

http://www.advantage-positioning.com https://venngage.com/blog/cover-letter-template/ https://www.thebalancecareers.com/cover-letter-format-2060205 https://stylingcv.com/ https://www.indeed.com/career-advice/interviewing/video-interview-guide https://www.wayup.com/guide/6-dos-and-donts-of-video-interviews/

EGB305/EGR305 COMMUNICATION AND NETWORKING

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	26
		Tutorial (T):	0
		Practical (P):	28
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

This module acquaints students with the fundamentals of computer communications and networking, their protocols and operations. It also equips students with sufficient practical knowledge in computer data networks and device communications that support shop-floor automation systems and solutions. At the end of the module, students will be able to apply the knowledge and competence acquired in computer and device communications to solve real life engineering problems.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Identify the computer networking components and communication devices.
2. Describe the fundamentals of computer networks and its applications.
3. Describe the computer networking communication standards and protocols.
4. Describe the purpose and application of IP addressing
5. Apply computer networking and device communications to support the shop-floor automation systems and solutions.

Topics

1 Fundamentals of Computers and Computer Networks
1.1 Introduction
1.2 Basics of Computer Hardware & Software
1.3 Computer Network Hardware & Software
1.4 Computer Network Terminology

2 Uses of Computer Networks
2.1 Return of Investment (ROI) for Computer Networks
2.2 Home Applications
2.3 Business Applications
2.4 Manufacturing Applications
2.5 Basics of Client-Server System

3 Local Area Networks (LAN)
3.1 Characteristics of LAN
3.2 Benefits of LAN
3.3 Application of LAN
3.4 Wireless LAN

4 Open System Interconnect (OSI) Reference Model
4.1 Importance of Communication Architecture
4.2 OSI Reference Model

5 OSI Reference Model – Transport Set
5.1 Functions of Physical Layer (Layer 1)
5.2 Types of Media and Connections
5.3 Network Topology
5.4 Functions of Data Link Layer (Layer 2)
5.5 Media Access Control (MAC)
5.6 Types of Media Access Control (MAC)
5.7 Functions of Network Layer (Layer 3)
5.8 Internet Protocol (IP) Addressing
5.9 Classes and Classless of IP Addressing
5.10 Functions of Transport Layer (Layer 4)
5.11 Quality of Service

6 OSI Reference Model – Application Set
6.1 Functions of Session Layer (Layer 5)
6.2 Functions of Presentation Layer (Layer 6)
6.3 Functions of Application Layer (Layer 7)

7 Transmission Control Protocol / Internet Protocol (TCP/IP)
7.1 TCP/IP Model

Assessment

Assignments	30%
Practical	20%
Project	
Class Participation	10%
Presentation	
Quiz	40%
Test	
Examination	

Texts & References

1. Wempen, Faithe, Computing Fundamentals: Introduction to Computers, Wiley
2. William Stallings, Computer Networking with Internet Protocols and Technology , Pearson/Prentice Hall
3. Eddie Kee, Networking Illustrated, Que

EG3245/EGB310/EG3245/EGR310 Wafer Fabrication Processes

Course:	Diploma in Electronics, Computer & Communications Engineering Diploma in Mechatronics Engineering Diploma in Electronics Systems Diploma in Robotics and Mechatronics		
Course Code:	EGDF01, EGDF02, EGDF18, EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	24
		Tutorial (T):	15
		Practical (P):	15
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

This module provides learners with essential knowledge of wafer fabrication processes for IC (integrated circuit) chips in the semiconductor manufacturing industry. Major topics covered include oxidation, diffusion, photolithography, etching, ion implantation, thin film deposition, chemical mechanical polishing, wafer cleaning, and process integration. Practical skills pertaining to these technologies will be emphasised in the laboratory to enhance the understanding of wafer fabrication in a semiconductor-manufacturing environment.

Module Learning Outcomes

At the end of this module, students will be able to:

1. explain the structure and fabrication processes of a MOS transistor on silicon wafer through cross-sectional diagrams.
2. Explain various wafer fabrication processes by describing their mechanisms and determining the process parameters through mathematical models.
3. Conduct simulations of various wafer fabrication processes using process simulator in Virtual Wafer Fabrication software.

Topics

1 Overview of Semiconductor Manufacturing Industry
1.1 Local semiconductor manufacturing industry
1.2 Overseas developments in semiconductor manufacturers

2 Overview of Wafer Fabrication
2.1 Introduction to wafer fabrication processes
2.2 Workings of a PMOS/ NMOS/ CMOS Transistor
2.3 Step-by-step process of fabricating a MOS transistor

3 Wafer Preparation
3.1 Silicon Basics
3.2 Wafer Manufacturing

4 Fundamentals of Wafer Fabrication
4.1 Diffusion
4.2 Oxidation
4.3 Photolithography
4.4 Ion Implantation
4.5 Thin Film Deposition
4.6 Etching
4.7 Chemical Mechanical Polishing

5 Wafer Cleaning
5.1 Clean chemistry and techniques

6 Process Integration for CMOS
6.1 Process loops

Assessment

Assignments	30%
Practical	30%
Project	10%
Class Participation	
Presentation	
Quiz	30%
Test	
Examination	

Texts & References

1. Jaeger, R. C. (2002). *Introduction to Microelectronic Fabrication*. Prentice Hall.
2. Campbell, S. A. (2001). *The Science and Engineering of Microelectronic Fabrication*. Oxford University Press.
3. Xiao, H. (2001). *Introduction to Semiconductor Manufacturing Technology*. Prentice Hall.
4. Zant, P. V. (2000). *Microchip Fabrication*. McGraw-Hill.

EGR314 Anatomy & Physiology

Course:	Diploma in Robotics ad Mechatronics		
Course Code:	EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	26
		Tutorial (T):	10
		Practical (P):	6
		eLearning (E):	18
Pre/Corequisite:	Nil		

Synopsis

This module aims at introducing to students the basic structure and functions of the human body. It covers the organization of functional systems of the human body as a whole, and the anatomy and physiology of individual systems such as the nervous, endocrine, blood, cardiovascular, respiratory, gastrointestinal, urinary, musculoskeletal, integumentary and immune systems. The knowledge acquired will serve as a tool to enable engineers to design or improve biomedical products.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Distinguish between the various body systems and describe the basic concept of physiological processes
2. Describe the structure and functions of the musculoskeletal, integumentary, cardiovascular, respiratory, nervous, immune, gastrointestinal, urinary, and endocrine systems
3. Describe the constituents and functions of blood

Topics

1. Introduction to human body systems
1.1. Functional systems of the human body
1.2. Anatomical terms and nomenclature
1.3. Homeostasis
1.4. Cell Biology

2. Musculoskeletal and integumentary systems
2.1 Structure and function of bones
2.2 Axial and appendicular skeletons
2.3 Structure and classification of joints
2.4 Structure and function of muscles

2.5 Integumentary system

3. Cardiovascular system
3.1 Structure of heart
3.2 Functions of heart
3.3 Structure and function of blood vessels
3.4 Regulation of circulation

4. Blood
4.1 Composition of blood
4.2 Functions of blood

5. Respiratory system
5.1 Structure of respiratory system
5.2 Mechanics of breathing
5.3 Gas exchange and transport

6. Nervous system
6.1 Organization of the nervous system
6.2 Central nervous and peripheral nervous systems

7. Immune system
7.1 Overview of immune system and functions
7.2 Principles of immune-regulation in human body

8. Other systems
8.1 Gastrointestinal system
8.2 Urinary system
8.3 Endocrine system

Assessment

Assignments	0 %
Practical	20 %
Project	0 %
Class Participation	10 %
Presentation	0 %
Quiz	30 %
Test	40 %
Examination	0 %

Texts & References

1. Martini F.H & Bartholomew E.F. Essentials of Anatomy and Physiology; Pearson

2. Susan Hall. Basic Biomechanics; McGraw Hill

3. VanPutte C., Regan J. and Russo A. Seeley's Essentials of Anatomy and Physiology; McGraw Hill

4. Tortora G.J. & Derrickson B.H. Principles of Human Anatomy & Physiology; Wiley

EGB315/EGR315 BIOMEDICAL MANUFACTURING TECHNOLOGY

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	18
		Tutorial (T):	0
		Practical (P):	30
		eLearning (E):	12
Pre/Corequisite:	Nil		

Synopsis

This module provides students with knowledge and skills for the biomedical manufacturing industry. It covers cleanroom technology, microengineering technology, automation and manufacturing system. Students will also understand the biomedical processes and utilities involved in making medical devices and pharmaceutics. The knowledge and skills acquired will prepare students for work in the biomedical and pharmaceutical manufacturing industries.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Describe the fundamentals of design, testing and operation of cleanrooms.
2. Explain the basic principles of fabrication by mechanical and silicon micromachining technology, common medical device manufacturing processes and pharmaceutical manufacturing processes.
3. Determine the appropriate manufacturing processes to produce medical devices and pharmaceutics.
4. Understand the application of automation in manufacturing and SCADA for process control in a manufacturing plant.

Topics

1 Introduction
1.1 Overview of Biomedical Industry in Singapore

2 Cleanroom Technology
2.1 Cleanroom Classification
2.2 Cleanroom Testing

3 Microengineering Technology
3.1 Mechanical Micromachining
3.2 Silicon Micromachining

4 Biomedical Manufacturing Processes and Utilities
4.1 Medical Device Manufacturing Processes
4.2 Pharmaceutical Manufacturing Processes
4.3 Utilities in Biomedical and Pharmaceutical

5 Automation and Manufacturing System
5.1 Industrial Control Systems
5.2 Manufacturing Systems

Assessment

Assignments	
Practical	15%
Project	15%
Class Participation	
Presentation	
Quiz	30%
Test	
Examination	40%

Texts & References

1. Whyte, W. (2010). *Cleanroom technology: Fundamentals of design, testing and operation.* Hoboken, NJ: John Wiley & Sons
2. Mikell P. Groover. (2012). *Introduction to Manufacturing Processes.* Hoboken, NJ: John Wiley & Sons
3. C.K. Chua, K.F. Leong, C.S. Lim. (2010). *Rapid prototyping: principles and applications.* Singapore: World Scientific
4. Mikell P. Groover. (2016). *Automation, production systems, and computer-integrated manufacturing*. Upper Saddle River, NJ: Pearson/Prentice Hall

EGR317 Medical & Assistive Devices

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	30
		Tutorial (T):	0
		Practical (P):	30
		eLearning (E):	100%
Pre/Corequisite:	EG1890 Engineering Drawing & Modelling (Prerequisite)		

Synopsis

This module will introduce students to the approaches used in product design, in particular medical and assistive devices. Students will be exposed to the design process and various product generation methodologies. The module also covers the classification of medical devices, failure mode and effects analysis, use of prototyping and design of experiments. Through this module, students will be able to undertake work in product design.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Explain how medical devices are classified and the different classifications adopted by the various countries. [SLO –g]
2. Select a concept with the most potential for success based on the techniques taught in understanding the design problem, generating concepts and evaluation. [SLO-a,d,i,k]
3. Design medical and assistive devices using the various product generation methodologies taught. [SLO-a,d,k]

Topics

1 Introduction

2 Medical & Assistive Devices
2.1 Definition of Medical & Assistive Devices
2.2 Classification of Medical Devices
2.3 Assistive Technology

3 Design process
3.1 Specification Development
3.2 Concept Generation
3.3 Concept evaluation
3.4 Failure mode and effects analysis (FMEA)

4 Product generation methodologies
4.1 Concurrent design
4.2 Design for manufacturability/assembly (DFMA)
4.3 Design of adhesive joint
4.4 Design of battery contact

5 Physical models and experimentation
5.1 Prototyping

Assessment

Assignments	30%
Practical	
Project	40%
Class Participation	
Presentation	
Quiz	30%
Test	
Examination	

Texts & References

1. Dieter, G. E., & Schmidt, L. C. (2013). Engineering design. London: McGraw-Hill.
2. Hill, D. (1998). Design engineering of biomaterials for medical devices. Chichester; New York: Wiley.
3. Otto, K. N., & Wood, K. L. (2001). Product design: techniques in reverse engineering and new product development. Upper Saddle River, NJ: Prentic Hall.
4. Ullman, D. G. (2010). The mechanical design process. Boston: McGraw-Hill Higher Education.

EGR318 Biomaterials

Course:	Diploma in Robotics & Mechatronics/ Mechatronics Engineering		
Course Code:	EGDF19/02		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L): 4	36
		Tutorial (T):	15
		Practical (P):	0
		eLearning (E):	9
Pre/Corequisite:	Nil		

Synopsis

This module aims to provide the students with an intrinsic knowledge of biomaterials. The topics covered include the definition of biomaterials, basic structures, physical & mechanical properties, degradation, manufacturing processes and medical applications of four main biomaterials: metal, polymer, ceramic and composite. By the end of this module, the students will have a firm understanding of different types of biomaterials and be able to compare and provide examples of biomedical applications of biomaterials.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Recognize biomaterials and biocompatibility based on the development of biomaterials.
2. Describe general aspects of material properties, testing and host responses of biomaterials using guidelines and standards for biomaterial development and testing.
3. Describe the basic structure, property, manufacturing process, and degradation process of biomaterials focusing on metallic, polymeric, ceramic and composite biomaterials.
4. Compare and provide examples of biomedical applications of biomaterials based on their properties and biocompatability.

Topics

1	Introduction
1.1	Definition of biomaterial and biocompatibility
1.2	Classification of biomaterial : biological performance, material type
1.3	Testing of biomaterials
1.4	Host responses to biomaterials and wound healing
1.5	Basic structure of materials
1.6	Material properties and characterisation

2	Metallic Biomaterials
2.1	Structure and mechanical properties of metal
2.2	Manufacturing process & classification
2.3	Common metallic biomaterials
2.4	Corrosion of metals in biological system
2.5	Medical applications of metallic biomaterial
3	Polymeric Biomaterials
3.1	Structure of polymer
3.2	Classification of polymer
3.3	Manufacturing process
3.4	Physical & mechanical properties of polymer
3.5	Degradation in biological system
3.6	Types of biopolymers and their applications
4	Ceramic & Glass Biomaterials
4.1	Structure and property of ceramics and glasses
4.2	Processing and classification of ceramics and glasses
4.3	Bioinert ceramics
4.4	Bioactive ceramics & glasses
4.5	Degradation of ceramics and glasses in biological system
4.6	Biomedical applications of ceramics and glasses
5	Composite Biomaterials
5.1	Structure and basic properties of composite
5.2	Fabrication and classification of composite
5.3	Mechanical and physical properties of composite
5.4	Reinforcing and matrix systems
5.5	Degradation of composite in biological system
5.6	Applications of composite biomaterials

Assessment

Assignments	10%
Practical	
Project	20%
Class Participation	5%
Presentation	
Quiz	30%
Test	35%
Examination	

Texts & References

1. Ratner BD, et al, Biomaterials Science : An Introduction to Materials in Medicine, Academic Press, 2012.

2. Callister, Jr., W.D., Materials Science and Engineering : An Introduction. John Wiley & Sons, Inc. 7th Edition, 2007.

3. Black J, Biological Performance of Materials : Fundamentals of Biocompatibility. CRC Press, Taylor & Francis, 4th Edition, 2005.

4. Park JB, Biomaterials Science and Engineering. Springer US, 1984.

EGB331/EGR331 Motion Control and Drives

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	24
		Tutorial (T):	0
		Practical (P):	18
		eLearning (E):	18
Pre/Corequisite:	Nil (Prerequisite)		

Synopsis

This module equips students with practical knowledge of motion control systems and the associated power electronics knowledge for drive applications. These drives are the prime movers of most mechatronics products and automation systems of today. At the end of the module, students will be able to apply the knowledge gained to real life engineering projects.

Module Learning Outcomes

At the end of this module, students will be able to:

1. describe various types of electric motors based on motion control applications.
2. describe the working principle of motion sensors and various types of power electrics drives based on industrial motion control application.
3. demonstrate the operation of a motion control system with a stepper or servo motor using an industrial automation software package.
4. write a program to operate a multiple-axis motion control system based on real-life industrial application.

Topics

1 Introduction to Motion Control System

- 1.1 Introduction
- 1.2 Overview of Motion Control System
- 1.3 Overview of Motion Programming
- 1.4 Industrial Application of Motion Control System

2. Electric Motors

- 2.1 Types and Characteristics of AC and DC Motors
- 2.2 Motors Selection and Applications

3. Control System and Feedback Devices

    3.1 Types of Control Systems
    3.2 Motion Sensors and Applications
    3.3 Speed Control and Position Control

4. Power Electronics and Drives

    4.1 Introduction to Power Electronics and Drives
    4.2 Driving a DC Motor with PWM Technique
    4.3 Implementation of a Single-axis Motion Control System

5. Stepper and Servo Motor Systems

    5.1 Overview of Stepper and Servo Motor System
    5.2 Types of Drive Circuits
    5.3 System Sizing and Selection

6. Mechanical Drive System

    6.1 Types and Characteristics of Drive Mechanisms
    6.2 Applications of Drive Mechanisms

7. Safety and Power Circuit Protections

    7.1 Types of Safety and Power Circuit Protections
    7.2 Applications of Safety and Power Circuit Protections

8. Programming an Industrial Application System

    8.1 Motion Profiles and Software Implementation
    8.2 Tuning of Motion Control System

Assessment

Assignments	
Practical	40%
Project	
Class Participation	
Presentation	
Quiz	
Test	20%
Examination	40%

Texts & References

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering by William Bolton. Sixth edition. Pearson.

2. Industrial Motion Control: Motor Selection, Drives, Controller Tuning, Applications by Hakan Gurocak. John Wiley & Sons. 1st edition.

3. Power Electronics for Technology by Ashfaq Ahmed, Upper Saddle River, NJ: Prentice Hall, 1988, c1999.

5. Power Electronics for the Microprocessor Age by Takashi Kenjo, Oxford University Press, 1994

EGB332/EGR332 Automation Systems Design

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	14
		Tutorial (T):	0
		Practical (P):	40
		eLearning (E):	6
Pre/Corequisite:	Nil (Prerequisite)		

Synopsis

This module aims to provide essential concepts and principles to support the design process of automation systems. The module also aims to synthesize diverse engineering fundamentals including the use of robotic work cell and various types of layout in such systems. Various aspects of manufacturing systems/technologies and an overview of automation assembly systems will be covered in this module. The lectures are complemented with practical design sessions using 3D computer-assisted drafting and design system. Upon successfully completing this module, students should be able to integrate their knowledge acquired from this module and other related engineering knowledge to perform design of automation systems.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Identify automation system by functions, layout and configuration.

2. Synthesize and select component for automated system building.

3. Design automation system using CADD software.

Topics

1	**Machine Classifications**
1.1	Definition of automation
1.2	Classification of Machines
1.3	Types of Machine Layouts
2	**Typical design-&-build projects**
2.1	Machine design process
2.2	Machine building process

3	**Drive systems and actuators in automated machines**
3.1	Concept of a drive system
3.2	Sizing of actuator
3.3	Electric motors
3.4	Pneumatic cylinders
3.5	Hydraulic cylinders
3.6	Solenoid actuators
4	**Work stations**
4.1	Work station basic
4.2	Work station requirements
5	**Feeder, part handling module and industrial robot**
5.1	Types of part feeder
5.2	Parts handling modules
5.3	Industrial robot
5.4	Types of robotic cell layout
5.5	Robotic system integration
6	**Machine control system and sensor**
6.1	Basic control system requirements
6.2	Types of controller
6.3	Manual and electromechanical switches
6.4	Proximity sensors
6.5	Photoelectric sensors
6.6	Machine vision system

Assessment

Assignments	
Practical	
Project	50%
Class Participation	20%
Presentation	
Quiz	
Test	30%
Examination	

Texts & References

1. K.W. Lentz, Jr., *Design of Automated Machinery*, Kluwer Academic Publishers; ISBN: 0412106418.
2. Mikell P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing,* 3rd Ed., Prentice Hall, 2008.

EGB333/EGR333 MECHANISMS DESIGN & SIMULATION

Course:	Diploma in Mechatronics Engineering Diploma in Robotics and Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	28
		Tutorial (T):	0
		Practical (P):	20
		eLearning (E):	12
Pre/Corequisite:	NA		

Synopsis

This module aims to equip students with knowledge to select and design mechanisms for automated machines and equipment. Coverage includes fundamental mechanism design principles, typical mechanisms and design considerations. Students will also learn computer simulation techniques in mechanism design. The focus is on the understanding of mechanism design principles and application of such knowledge in the development of automation devices and machines. This module will train students to be able to analyse, model and develop mechanisms to solve problems in automation industry.

Module Learning Outcomes

At the end of this module, students will be able to:

1. construct a kinematic diagram of a simple linkage mechanism given the number of links and joints.
2. determine the relative and absolute velocity of links using the velocity diagram.
3. determine the relative and absolute acceleration of links using the acceleration diagram.
4. construct specified function, path and motion of a linkage mechanism using the graphical synthesis method.
5. draw a cam profile to drive the linkage mechanism based on the follower displacement diagram.

Topics

1 **Introduction**

1.1 Mechanisms and simple machines

1.2 Part transfer and singulation mechanisms

2 Kinematics fundamentals

2.1 Degrees of freedom

2.2 Types of motion

2.3 Links, joints, chains

3 Velocity Analysis

3.1 Velocity of a point or a link

3.2 Relative velocity

3.3 Graphical velocity analysis: relative velocity method

4 Acceleration Analysis

4.1 Linear acceleration of a point in general motion

4.2 Acceleration of a link

4.3 Normal and tangential acceleration

4.4 Relative acceleration

4.5 Relative acceleration analysis: Graphical method

5 Linkage design

5.1 Graphical synthesis

5.2 Quick return mechanism

5.3 Dwell mechanism

6 Cam design

6.1 Types of cam

6.2 Motion diagram

6.3 Cam profile

Assessment

Assignments	
Practical	40%
Project	
Class Participation	
Presentation	
Quiz	30%
Test	30%
Examination	

Texts & References

1. Shigley, J. E. and Uicker, J. J., Jr., Theory of Machines and Mechanisms, McGraw-Hill, New York, 1980.
2. Chen, F. Y., Mechanics and Design of Cam Mechanisms, Pergamon Press, New York, 1982.
3. Hartenberg, R. S. and Denavit, J., Kinematic Synthesis of Linkages, McGraw-Hill, New York, 1980.
4. Sandor, G. and Erdman, A., Advanced Mechanism Design: Analysis and Synthesis, Prentice-Hall, New Jersey, 1984.
5. Neil S., Mechanisms and Mechanical Devices Sourcebook (5th Ed.), New York: McGraw-Hill, 2011.

Course : Diploma in Robotics & Mechatronics

Course Code : EGDF19

Year : 3rd

Module : Systems & Control

Module Code : EGR334

Hours (Credits) : 60 (4)

Lecture (L) : 30
Tutorial (T) : 0
Practical (P) : 30

Prerequisite : Differential Equation & Series

Learning Outcomes :

At the end of this module, students will be able to:

1. describe the control system using transfer function and block diagram.[SLO-a,e]

2. interpret the characteristic of the time response of the first and second order systems.[SLO-a,b,d,k]

3. recognize the importance and benefits of the feedback control system and the role of PID controller in the feedback control systems. [SLO-a,d,k]

4. sketch the Bode plot of a control system and estimate its relative stability based on phase and gain margin.[SLO-a,d,k]

5. discuss the stability of the closed-loop system using Bode plot, S-plane analysis, Routh-Hurwitz and Nyquist stability criteria.[SLO-a,d,k]

Topics:

1. Introduction

2. Mathematical Model of Physical Systems

2.1 Differential equation of physical systems

2.2 Laplace transform

2.3 Transfer function

2.4 Block diagram

3. Time response of physical systems

3.1 Transient response

3.2 Steady-state response

3.3 Computer simulation of system

4. Feedback control systems

4.1 Transfer function of closed-loop system

4.2 Disturbance input

4.3 PID controller

4.4 Computer simulation of closed-loop systems

5. Stability study

5.1 Frequency response method

5.2 Routh-Hurwitz stability criterion

5.3 S-plane analysis

5.4 Nyquist stability criterion

5.5 Software tools for stability study

EGB341/EGR341 Aerospace Manufacturing System

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	24
		Tutorial (T):	30
		Practical (P):	0
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

This module equips students with the operating principles and applications of manufacturing systems in the aerospace industry. This includes the classification of production systems, concepts of manufacturing resource planning, JIT, group technology, flexible manufacturing system (FMS), principles & practices of lean manufacturing and the application of computer-aided design/manufacturing (CAD/CAM).

Module Learning Outcomes

At the end of this module, students will be able to:

1. Provide examples of operating principles and the use of different manufacturing systems in aerospace industry.
2. Describe and apply principles of various Total Quality Management Tools.
3. Describe objectives of Lean Manufacturing and how it can be implemented in the aerospace industry.

Topics

1 Introduction

1.1 Aircraft Design for Manufacturing and Assembly
1.2 Types of Aerospace Materials and Manufacturing Methods
1.3 Aerospace Quality Systems
1.4 Manufacturing System and Supply chain management system

2 Manufacturing Organisation

2.1 Activities within Plant
2.2 Location/allocation analysis
2.3 Design for Manufacturing (DFM)
2.4 Plant Layout

3 Group Technology

3.1 Overview of Group Technology
3.2 Part Family and Classification Systems
3.3 Benefits of a well- designed classification and coding system
3.4 Effects of Group Technology in a manufacturing organization
3.5 Benefits of Group Technology

4 Just-In-Time (JIT)

4.1 Introduction to JIT
4.2 Total Quality Control
4.3 JIT Flow
4.4 Pull vs Push Method
4.5 Kanban System
4.6 Summary

5 Flexible Manufacturing System (FMS)

5.1 What is Flexible Manufacturing System (FMS)
5.2 Computer Integrated Manufacturing (CIM)
5.3 Modern CAD/CAM System
5.4 Success of FMS

6 Total Quality Management(TQM)

6.1 Total Quality and Continuous Improvement
6.2 What is PDCA?
6.3 Understanding quality: Metrics, Approaches and the Types of Quality
6.4 Six Sigma
6.5 Statistical Process Control (SPC)

7 Lean Manufacturing

7.1 What is Lean?
7.2 Pull Manufacturing
7.3 Lean Tools
7.4 Elimination of Waste
7.5 Value Stream Mapping
7.6 Lean Manufacturing in Aerospace Industry

Assessment

Assignments	
Practical	
Project	
Class Participation	10%
Presentation	
Quiz	30%
Test	60%
Examination	

Texts & References

1. Introduction to Manufacturing Processes, John A. Schey
2. Manufacturing Engineering and Technology, Serope Kalpakjian, Steven Schmid
3. Fundamentals of Machining Processes, Hassan El-Hofy
4. Automation, Production Systems, and Computer Integrated Manufacturing, Mikell P. Groover

EGB342/EGR342 AEROSPACE MATERIALS AND NDT

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	26
		Tutorial (T):	0
		Practical (P):	28
		eLearning (E):	6 (10%)
Pre/Corequisite:	Nil		

Synopsis

This module is designed in two parts. Firstly, to expose students to the types and properties of aerospace materials and secondly to expose students to the principles and applications of non-destructive evaluation tools. Topics for the aerospace materials covered include aluminium alloys, titanium alloys, superalloys and composite materials – their properties and their applications in the aerospace industry. Topics for non-destructive testing covered include visual inspection, dye penetration inspection, magnetic particle testing, ultrasonic inspection, eddy current inspection and radiography. At the end of the module, students will be able to describe the engineering materials and the non-destructive evaluation methods used in aerospace industry.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Describe aerospace materials (aluminium alloys, titanium alloys, superalloys and composites) by listing their engineering properties.
2. Relate and justify the materials selected for aerospace applications by considering the properties of various alloys and composites vis-à-vis aircraft requirements.
3. Describe the various non-destructive test methods based on their operating principles and applications.
4. Select non-destructive test method for aerospace applications by considering the suitability and the limitations of the method

Topics

1 Introduction to Aerospace Materials
1.1 Introduction
1.2 Classes of Materials
1.3 Material Properties / Selection
1.4 Design Requirements

2 Aluminium Alloys
2.1 Introduction
2.2 Properties
2.3 Classification of Al Alloys
2.4 Strengthening Mechanisms
2.5 Aerospace Al Alloys
2.6 Joining of Al Alloys

3 Titanium Alloys
3.1 Introduction
3.2 Properties
3.3 Classification of Ti Alloys
3.4 Ti Alloys
3.5 Joining of Ti Alloys

4 Superalloys
4.1 Introduction
4.2 Classification
4.3 Properties
4.4 Nickel-base Superalloys
4.5 Cobalt-base Superalloys
4.6 Iron-base Superalloys

5 Composites
5.1 Introduction
5.2 Classification of composites
5.3 Properties
5.4 Composites in Aerospace Applications
5.5 Joining of Composites

6. Non-Destructive Testing (NDT)

6.1 Visual Inspection
Types of Visual Inspection
Conditions affecting Visual Inspection
Advantages & Disadvantages

6.2 Liquid Penetrant Inspection
Principles of Liquid Penetrant Inspection
Process of Liquid Penetrant Inspection
Advantages & Disadvantages

6.3 Magnetic Particle Inspection
Principles of Magnetic Particle Inspection
Process of Magnetic Particle Inspection

Advantages & Disadvantages

6.4 Ultrasonic Inspection
Principles of Ultrasonic Inspection
Instrument and Process of Ultrasonic Inspection
Advantages & Disadvantages

6.5 Eddy Current Testing
Principles of Eddy Current Testing
Advantages & Disadvantages

6.6 Radiographic Inspection
Principles of Radiographic Inspection
Radiographic Image Quality
Advantages & Disadvantages

Assessment

Assignments	
Practical	40%
Project	
Class Participation	
Presentation	
Quiz	
Test	20%
Examination	40%

Texts & References

1. "Materials Science & Engineering-An Introduction", W.D.Callister
2. "Foundations of Materials Science and Engineering", William F Smith and Javad Hashemi
3. "Superalloys II", Chester Sims, Norman Stoloff and William Hagel
4. Nondestructive Testing Techniques", Don E Bray and Don McBride.

EGB343/EGR343 Computer-Aided Manufacturing/Engineering

Course:	Diploma in Mechatronics Engineering Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	12
		Tutorial (T):	12
		Practical (P):	30
		eLearning (E):	06
Pre/Corequisite:	NIL (Prerequisite)		

Synopsis

This module introduces the use of Computer Numerical Control (CNC) and Computer-Aided Manufacturing (CAM) application software. Students will be taught on manual part programming and generate tool paths from complex CAD models using CAM software package. On completion of the module, the student will be able to produce manual part programs using Heidenhain iTNC530 controller, generate NC tool path using CAM software and verify the tool path with NC simulation software.

Module Learning Outcomes

At the end of this module, students will be able to:
1. Understand the concept of CNC Milling Part Programming
2. Write CNC Milling Part Program using Heidenhain iTNC530 controller
3. Sketch 2D geometry and build into 3D solid models with CAD software
4. Perform tool path generation and NC program verification using CAM software

Topics:

1. Introduction

1.1 Introduction computer-aided design and manufacturing

2. CNC Milling Part Programming

2.1 Methods of part programming and data processing
2.2 Machine features and controller
2.3 Manual part programming
2.4 Programming linear profile
2.5 Programming with cutter radius compensation

3. Design using Sketching

3.1 Create 2D Sketch geometry
3.2 Constraining sketch geometry and 3D feature creation

4. Solid Modelling

4.1 Solid modelling
4.2 Boolean operations
4.3 Feature modelling

5. NC Tool Path Generation

5.1 Planar milling
5.2 Face milling
5.3 Cavity milling
5.4 Contour milling

6. NC Tool Path Simulation and Verification

6.1 Tool path simulation and verification
6.2 Post-processing of tool paths

Assessment

Assignments	10%
Practical	40%
Project	
Class Participation	20%
Presentation	
Quiz	
Test	30%
Examination	

References:

1. "An introduction to CNC machining and programming", Gibbs and Crandell.

2. "Fundamentals of numerical control", William W. Luggen.

3. "Computer numerical control", Joseph Pusztai and Michael Save.

EGB344/EGF305/EGR344 – RELIABILITY AND FAILURE ANALYSIS

Course:	Diploma in Mechatronics Engineering Diploma in Aeronautical & Aerospace Technology Diploma in Robotics & Mechatronics		
Course Code:	EGDF02/EGDF11/EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	23
		Tutorial (T):	19
		Practical (P):	0
		eLearning (E):	18
Pre/Corequisite:	Nil		

Synopsis

This module aims to introduce students to the concepts of safety factors and reliability relating to aircraft structure and systems. Topics covered include probability, risk assessment, maintainability, reliability testing, as well as, reliability-based design and evaluation. This module is also designed to expose students to failure analysis of aerospace components and structures, relating the mechanisms of failures to the mechanical, micro-structural and operating conditions. Other topics covered include types and mechanisms of overload, fatigue, creep, wear and corrosion failures in metallic and composite materials. At the end of the module, students will be able to analyse and solve reliability and engineering failure problems encountered in the industry

Module Learning Outcomes

At the end of this module, students will be able to:

1. Apply reliability principles using deterministic data obtained from reliability testing or maintenance activity to estimate the life of a product or process into future time.
2. Describe failure analysis by discussing the methodology and its purpose.
3. Identify the typical failures encountered in the aerospace industry based on their failure mechanisms and characteristics.
4. Describe the mechanisms of failures by considering and relating to the mechanical, micro-structural and operating conditions.

Topics

1 Basic Concept of Reliability Engineering
1.1 Introduction to Reliability
1.2 Product failures and life cycle

2 Common Reliability Measurements
2.1 Definition of common reliability measurement terms

2.2 Solving reliability problems using mathematical techniques and FMEA risk assessment methodology.
3 System Reliability
3.1 Types of system reliability
3.2 Design for optimum reliability

4 Aerospace Product Testing and Evaluation
4.1 Types of reliability testing
4.2 Evaluation of time and highly accelerated tests

5 Introduction to Failure Analysis
5.1 Failure of Engineering Products
5.2 Failure Analysis

6 Failure Modes and Mechanisms
6.1 Failure Mode and Mechanisms
6.2 Failure Mode Identification

7 Overload Failures
7.1 Introduction to Overload Failures
7.2 Ductile Overload
7.3 Brittle Overload

8 Fatigue Failures
8.1 Introduction
8.2 Fatigue Fracture
8.3 Fatigue Life Assessment
8.4 Preventive Measures

9 Creep Failures
9.1 Introduction
9.2 Creep Damage
9.3 Preventive Measures

10 Corrosion
10.1 Introduction
10.2 Forms of Corrosion
10.3 Preventive Measures

11 Wear
11.1 Introduction
11.2 Types of Wear
11.3 Preventive Measures

12 Failure of Composites

12.1 Introduction
12.2 Composite Failures

Assessment

Assignments	50%
Practical	
Project	
Class Participation	
Presentation	
Quiz	20%
Test	30%
Examination	

Texts & References

1. "Engineering Reliability: Fundamentals and Applications," R. Ramakumar
2. "An Introduction to Reliability and Quality Engineering", John P. Bentley
3. "Failure Analysis and Prevention", ASM Handbook Vol 11
4. "Practical Engineering Failure Analysis", H. M. Tawancy et al

Course : Diploma in Robotics & Mechatronics

Course Code : EGDF19

Year : 3rd

Module : Aircraft Propulsion System

Module Code : EGR345

Hours (Credits) : 60 (4)

Lecture (L) : 30
Tutorial (T) : -
Practical (P) : 30

Prerequisite : NA

Learning Outcomes :

At the end of this module, students will be able to:

1. describe the fundamental physics of gas turbine propulsion and interpret how thrust is produced and measured in gas turbine engines.
   [SLO – b, m]

2. identify the construction of gas turbine engines and recognize the functions of air inlet ducts, compressors, diffusers, combustors, turbine blades and vanes in the operation of a gas turbine engine.
   [SLO – m]

3. describe the basic functions of oil lubrication and turbine cooling system for a gas turbine engine and explain the importance of oil temperature, pressure, quantity and filter.
   [SLO – m]

4. interpret combustion process and describe the functions and features of a turbine fuel system.
   [SLO – m]

5. explain the functions of turbine engine exhaust and its role in producing thrust.
   [SLO – m]

6. illustrate the principle of aircraft fire protection and extinguishing system.
   [SLO – m]

7. describe engine control and instrumentation.
   [SLO – m]

8. apply the principle of gas turbine engine operation and maintenance including safety precaution, starting sequence, improper start management, inspection and maintenance programs. [SLO – b]

Topics:

1. Principles of Propulsion
- 1.1 Introduction
- 1.2 Overview of Aircraft Power Plants
- 1.3 Physics of Gas Turbine Propulsion
- 1.4 The Production of Thrust in Gas Turbine Engines

2. Construction of Gas Turbine Engines (Cold Section)
- 2.1 Air Inlet Ducts
- 2.2 Compressors
- 2.3 Diffusers
- 2.4 Accessory Systems

3. Construction of Gas Turbine Engines (Hot Section)
- 3.1 Combustion Section
- 3.2 Turbine Section

4. Lubrication And Cooling Systems
- 4.1 Types of Lubrication Systems
- 4.2 Lubrication System Sub-systems
- 4.3 Bearings and Seals
- 4.4 Lubrication System Components
- 4.5 Lubrication System Instrumentation
- 4.6 Lubrication System Servicing
- 4.7 Oil Analysis
- 4.8 Turbine Engine Cooling System

5. Aircraft Fuel System
- 5.1 Combustion Process
- 5.2 Aviation Fuels
- 5.3 Fuel System Requirements
- 5.4 Types of Aircraft Fuel Systems
- 5.5 Fuel System Components
- 5.6 Fuel System Instruments
- 5.7 Fuel System Plumbing
- 5.8 Refueling and Defueling

6. Turbine Fuel Metering System
- 6.1 Turbine Engine Fuel System
- 6.2 Engine Fuel System Components
- 6.3 Turbine Engine Fuel Control

7. Exhaust Systems
- 7.1 Turbine Engine Exhaust Systems

8. Fire Protection Systems

8.1 Classification of Fire
8.2 Fire Detection Systems
8.3 Fire Extinguishing Systems
8.4 Complete Fire Protection Systems
8.5 Maintenance and Servicing

9. Ignition and Starting Systems

9.1 High Energy Ignition Systems
9.2 Turbine Engine Starting Systems

10. Engine Control and Instrument Systems

10.1 Engine Controls
10.2 Engine Instruments
10.3 Electronic Instrumentation

11. Operation and Maintenance

11.1 Starting Gas Turbine Engines
11.2 Turbine Engine Troubleshooting
11.3 Turbine Engine Maintenance Programs
11.4 Borescope Inspection
11.5 Pre-flight Routine Inspection
11.6 Cold Section Inspection
11.7 Hot Section Inspection
11.8 Non-routine Inspections

EGR346 VACUUM TECHNOLOGY & RF PLASMA

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	0
		Tutorial (T):	15
		Practical (P):	15
		eLearning (E):	30
Pre/Corequisite:	Nil		

Synopsis

This module aims to develop learners with essential fundamental knowledge in vacuum technology applicable to wafer fabrication processes. Topics includes: fluid flow and pumping concepts, vacuum pumps and vacuum pressure measurement techniques, vacuum system design, vacuum leak detection methods and hardware components. The concept of RF plasma basics, impedance matching network and process parameter effects will also be imparted to learners.

Module Learning Outcomes

At the end of this module, learners will be able to:

1. Explain the concepts of vacuum generation, fluid flow and pumping
2. Apply vacuum pumps and pressure gauges in various applications
3. Design a simple vacuum system and identify leaks in the vacuum system
4. Solve network matching problem for RF plasma system
5. Explain the process parameter effects on plasma etching machines

Topics

No.	Topic Title
1	**Introduction to Vacuum**
1.1	Definition and units of measure
1.2	Vacuum spectrum
1.3	Production and applications of vacuum in semiconductor manufacturing
2	**Fluid Flow and Pumping Concepts**
2.1	Properties of gases
2.2	Common vacuum terminology
2.3	Mean free path and its relation to pressure

2.4	Flow regimes
3	**Vacuum System Design**
3.1	Vacuum conductance
3.2	Pumping speed and effective pumping speed
3.3	Outgassing effects and its relation to ultimate pressure
3.4	Evacuation time
3.5	Design considerations
4	**Vacuum Pumps and Measurement Systems**
4.1	Rough vacuum pumps
4.2	High vacuum pumps
4.3	Ultra high vacuum pumps
4.4	Backing pump sizing techniques
4.5	Mechanical phenomena pressure gauges
4.6	Transport phenomena pressure gauges
4.7	Ionization phenomena pressure gauges
4.8	Residual gas analysers
5	**Vacuum Leak Detection and Hardware Component**
5.1	Introduction
5.2	Real leaks and virtual leaks
5.3	Quantifying leaks
5.4	Leak detection methods
6	**RF Plasma Basics**
6.1	Introduction
6.2	Gas phase collision processes
6.3	Plasma potential and sheath formation at a floating substrate
7	**Matching Networks**
7.1	Introduction
7.2	Direct coupling
7.3	Transformer coupling
7.4	“L” network
7.5	“PI” network
8	**Process Parameter Effects**
8.1	Plasma etching, RIE and sputter etching
8.2	Types of dry etching
8.3	Effect of pressure, energy, temperature and gas flow rate on etch rate
8.4	Effect of Macroloading and Microloading

Task	Task Weighting (%)	Method	Method Weighting (%)
ASSNX	0	Assignment	0
PRAC1	20	Practical	30
PRAC2	10		
PRESX	0	Presentation	0
PROJ1	20	Project	20
TEST1	25	Test	50
TEST2	25		

Texts & References
1. Timothy A. Gessert, *Overview of Vacuum Technology* [AIP Publishing (online), Melville, New York, 2021
2. A. Berman (1985), *Total Pressure Measurements in Vacuum Technology*, Academic Press 1985
3. Pascal Chabert (2011), *Physics of Radio-Frequency Plasmas*, Cambridge University Press
4. George Domingo (2020). *Semiconductor Basics: A Qualitative, Non-mathematical Explanation of How Semiconductors Work and How They Are Used.* John Wiley & Sons Ltd

EG3244/EGB347/EGJ302/EG3244/EGR347 Semiconductor Technology

Course:	Diploma in Electronics, Computer & Communications Engineering Diploma in Mechatronics Engineering Diploma in Nanotechnology and Materials Science Diploma in Electronic Systems Diploma in Robotics and Mechatronics		
Course Code:	EGDF01, EGDF02, EGDF13, EGDF18, EGDF19		
Year:	3		
Duration / Credits:	60 Hrs / 4	Lecture (L):	24
		Tutorial (T):	15
		Practical (P):	15
		eLearning (E):	6
Pre/Corequisite:	Nil		

Synopsis

Major topics covered in this module include classification of cleanrooms, a study of major IC devices, parametric testing, failure analysis and reliability engineering. Practical skills pertaining to these topics will be realized in laboratory to enhance the understanding of semiconductor technologies in a real manufacturing environment. At the end of the module, learners will be able to apply the knowledge gained to real life engineering problems involving parametric testing, failure analysis and reliability engineering.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Explain the semiconductor fabrication environment by identifying the basic chemistry and chemicals employed in cleanroom.
2. Evaluate the electrical properties and doping process of semiconductors through semiconductor physics.
3. Explain the operation of various integrated circuits (IC) devices by determining their operation modes and constraints through device physics.
4. Differentiate the quality and reliability aspects of IC through interpreting statistical process control techniques and reliability mechanisms.
5. Classify various aspects of IC test, packaging & assembly processes and failure analysis through flow charts and descriptions of the flow.

Topics

1 Semiconductor Introduction
1.1 Introduction to semiconductors
1.2 Basic semiconductor chemistry
1.3 Introduction to cleanroom technology

2 Semiconductor Device Physics
2.1 Introduction to modern physics
2.2 Device Physics

3 IC Semiconductor Devices
3.1 P-N junction
3.2 Bipolar Junction Transistor (BJT)
3.3 Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

4 IC Quality and Reliability
4.1 Introduction to quality & reliability
4.2 What is Quality?
4.3 Statistical Process Control
4.4 What is Reliability?
4.5 Reliability Failure Mechanisms
4.6 Reliability tests

5 IC Testing, Assembly & Packaging
5.1 IC testing, yield & defect level
5.2 IC assembly process
5.3 IC package classifications

6 IC Failure Analysis (FA)
6.1 Introduction to FA
6.2 FA process flow
6.3 FA case study

Assessment

Assignments	30%
Practical	30%
Project	10%
Class Participation	
Presentation	
Quiz	30%
Test	
Examination	

Texts & References

1. Sze, S. M. (2002). *Semiconductor Devices: Physics and Technology* (2nd ed.). Wiley.
2. Sze, S. M., & Ng, K. K. (2007). *Physics of Semiconductor Devices* (3rd ed.). Wiley.
3. McPherson, J. W. (2013). Reliability Physics and Engineering (2nd ed.). Springer.

EGR323 Internship Programme

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR323		
Year:	3		
Duration / Credits:	12 Weeks / 12	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	12 Weeks
		eLearning (E):	0
Pre/Corequisite:	Nil		

Synopsis

This module enables students to enhance their learning by relating and applying their knowledge and skills to practice in real-life work environments. This will allow students to gain work-cantered knowledge and skills, and work-related experiences. In addition, they will acquire important work values, which include being responsible and positive, and exercising integrity, work ethics and interpersonal communication skills. Through this work-based experiential program, they will be better prepared for entry into the workforce.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job function/s
2. Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course
3. Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement
4. Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means
5. Exhibit critical thinking and problem solving skills by analysing underlying issue/s to challenges
6. Demonstrate the ability to harness resources by analysing challenges and considering opportunities
7. Recommend ideas to improve work effectiveness and efficiency by analysing challenges and considering viable options
8. Demonstrate appreciation and respect for diverse groups of professionals by engaging harmoniously with different company stakeholders
9. Exhibit professional ethics by displaying positive disposition during internship

Assessment

Assignments	80%
Practical	
Project	
Class Participation	
Presentation	20%
Quiz	
Test	
Examination	

Texts & References

Nil

EGR324 FULL TIME SEMESTRAL PROJECT

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR324		
Year:	3		
Duration / Credits:	12 Weeks / (12)	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	12 weeks
		eLearning (E):	0
Pre/Corequisite:	NA		

Synopsis

This module enables students to put into practice the knowledge and skills they have acquired from the course to develop solutions for real-life applications. Projects will be assigned to students who will work under staff supervision to develop and produce the desired project deliverables. In addition to equipping the students with technical and soft skills for project development, this module will enable students to develop problem solving skills and instil the habit of lifelong learning to prepare them for entry into the workforce.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Apply knowledge and skill sets acquired from the course, as well as critical thinking & problem solving skills and ethical considerations in developing solution for real-life application.
2. Plan, organize and review project activities and schedule using project management tool to deliver the set goals within the given timeline
3. Think critically with a multi-disciplinary perspective and harness relevant resources to develop innovative solution.
4. Recognise challenges and embrace them as opportunities to generate creative ideas and/or innovative solution
5. Collaborate and communicate effectively and responsibly with relevant stakeholders for effective and smooth project execution and implementation
6. Exhibit oral and written communication skills for effective sharing and transfer of knowledge.

Assessment

Assignments	-
Practical	-
Project	100%
Class Participation	

Texts & References

1. Full-Time Semestral Project guides and assessment rubrics

EGR325 INTERNSHIP PROGRAMME

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR325		
Year:	3		
Duration / Credits:	24 Weeks / (24)	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	24 weeks
		eLearning (E):	0
Pre/Corequisite:	NA		

Synopsis

This module enables students to put into practice the knowledge and skills that they have acquired from the course in real-life work environments. The students will be assigned work tasks or projects, with clear learning outcomes that are relevant to their courses and intended job roles, during the internship. The students will be guided by mentors from the industry and NYP to help them perform on the job and to achieve the learning outcomes. This will allow students to gain work-centered knowledge and skills, and work-related experiences. In addition, they will acquire important work values and ethics which include being responsible and positive, as well as taking initiative and exercising integrity. Through this work-based experiential program, students will be better prepared for work and life.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job function/s
2. Solve real life challenges in the workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course
3. Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement
4. Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means
5. Exhibit critical thinking and problem solving skills by analysing underlying issue/s to challenges
6. Demonstrate the ability to harness resources by analysing challenges and considering opportunities
7. Recommend ideas to improve work effectiveness and efficiency by analysing challenges and considering viable options
8. Demonstrate appreciation and respect for diverse groups of professionals by engaging harmoniously with different company stakeholders
9. Exhibit professional ethics by displaying positive disposition during internship.

Assessment

Assignments	80%
Practical	
Project	
Class Participation	
Presentation	20%
Quiz	
Test	
Examination	

Texts & References

1. Internship guides and assessment rubrics

EGR326 OVERSEAS INTERNSHIP PROGRAMME

Course:	Diploma in Robotics & Mechatronics		
Course Code:	EGR326		
Year:	3		
Duration / Credits:	24 Weeks / (24)	Lecture (L):	0
		Tutorial (T):	0
		Practical (P):	24 weeks
		eLearning (E):	0
Pre/Corequisite:	NA		

Synopsis

This module enables students to put into practice the knowledge and skills that they have acquired from the course in real-life work applications. The students will be assigned work tasks or projects that are relevant to their courses and intended job roles, during the overseas internship. The students will be guided by mentors from the industry, company or institution to help them perform on the projects or tasks. This will allow students to gain project or task-related knowledge, skills, and experiences. In addition, they will acquire important work values and ethics which include being responsible and positive, as well as taking initiative and exercising integrity. This module will also enable students to develop problem solving skills, instil the habit of lifelong learning and develop a global mind-set to prepare them for entry into the workforce.

Module Learning Outcomes

At the end of this module, students will be able to:

1. Demonstrate the application of knowledge and skill sets acquired from the course and overseas workplace in the assigned job function/s
2. Solve real life challenges in the overseas workplace by analysing work environment and conditions, and selecting appropriate skill sets acquired from the course
3. Articulate career options by considering opportunities in company, sector, industry, professional and educational advancement
4. Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means
5. Exhibit critical thinking and problem solving skills by analysing underlying issue/s to challenges
6. Demonstrate the ability to harness resources by analysing challenges and considering opportunities
7. Recommend ideas to improve work effectiveness and efficiency by analysing challenges and considering viable options
8. Demonstrate appreciation and respect for diverse groups of professionals by engaging harmoniously with different company stakeholders

9. Exhibit professional ethics by displaying positive disposition during overseas internship

Assessment

Assignments	80%
Practical	
Project	
Class Participation	
Presentation	20%
Quiz	
Test	
Examination	

Texts & References

1. Internship guides and assessment rubrics