DEPARTMENT OF MECHANICAL ENGINEERING
COURSE HANDBOOK

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Yamang, F

Administration Team

Senior Secretary
Kapipi, G. Certificate in Stenography

Secretary I
Ilo, D. Basic Secretarial Training

Janitor

Talaso Naemon

Gual Paias

MECHANICAL ENGINEERING IN BRIEF

VISION

To be a nationally and regionally recognized mechanical engineering department that attracts, rewards, and retains outstanding students, and academic and support staff.

MISSION STATEMENT

A. To produce competent, ethical, and moral graduates of high quality and in sufficient numbers to serve the needs of Papua New Guinea and the neighboring countries of the South Pacific in the field of Mechanical Engineering.

B. To develop a strong graduate program to enhance research activities and active commercial and community service operations to further serve the needs of the country and the South Pacific region.

EMPLOYABILITY OF MECHANICAL ENGINEERS

There is a wide range of employment opportunities for mechanical engineering graduates in Papua New Guinea, particularly in the fields of manufacturing, power, mining, liquefied natural gas (LNG) agriculture, maintenance of plant and machinery, transport, and rural and community development. Activities of graduates include design, supervision of maintenance,

planning, and supervision of engineering projects, production processes and process control, sales, and management.

The program is designed with the objective to ensure that the graduates within a few years after graduation will be recognized as experts to solve mechanical engineering problems and assume leadership/managerial positions in industry, professional community, and government. They should be able to enhance their academic career through advanced studies and lifelong learning.

The department is presently undergoing the accreditation of the Undergraduate (UG) program with the Washington Accord since 2015. The department was given provisional accreditation of the UG program in 2019 and continues to progress to get fully accredited by the end of 2024. Accreditation is a significant mark of assurance that the Mechanical programs meet the high standards set by the engineering profession. All the laboratories in the department are in the process of being modernized with the latest lab equipment and software according to the requirements of the accreditation.

BACHELORS PROGRAM

The Department offers a course leading to the degree of Bachelor of Engineering in Mechanical Engineering. The course involves four years of full-time study post-Grade 12 entry.

The undergraduate teaching in the Department is aimed at providing a broad and solid basis in fundamental Mechanical Engineering and at the same time offering relevant workshop experience and management studies.

The program outcomes are comparable to Washington Accord on student outcomes. Accordingly, the mechanical engineering teaching and learning efforts are focused on developing student's abilities in the application of mathematics, science, and engineering principles to solve practical problems, designing systems, components, and processes within realistic constraints of economic, political, ethical, social, environmental, health and safety, and sustainability. Efforts are also focused on students developing personal qualities in effective communication, multidisciplinary team participation, interpersonal skills, life-long learning, and contemporary global issues.

The first year of the course is basically common to all engineering students with the exception of one or two department-specific subjects. This consists of the study of language, mathematics, physics, chemistry, engineering, drawing, computing, workshop practice, and introduction to mechanical engineering.

Students who have successfully completed a Foundation Year Science Programme at the University of Papua New Guinea or another equivalent institution may be admitted to the second year but will be required to complete a bridging course in Drawing, Workshop Practice, and other subjects prescribed by the Department before the commencement of Semester 1.

The second and third years consist of further studies to develop analytical skills in Mechanical Engineering Sciences - Thermo fluids, Applied Mechanics, Engineering Materials, Drawing and Design, Manufacturing Processes, Industrial Electronics, Industrial Engineering and Management, and Language or Surveying studies.

The fourth year consists of more advanced studies in Thermo fluids, Applied Mechanics, and Design, together with studies in Manufacturing Technology and further Industrial Engineering and Management. A special feature of this year is that students are required to undertake a major engineering project. Also, students are allowed to choose elective subjects in the second semester.

It is not possible for students to obtain, within the University, anything to replace the fundamentals of practical experience and knowledge of engineering processes, which is essential to the engineer's development. So, students taking the regular course are required to accumulate at least twelve weeks of professional work experience in the latter part of the course during their vacations. The Head of the Department must approve this training and all students are required to submit a diary and report at the end of each training period. Completion of at least twelve weeks of approved practical training and completed diaries and satisfactory reports covering that period are necessary requirements for graduation.

ENTRY REQUIREMENTS & PROCEDURES

The minimum entry requirement is Grade 12 or an equivalent qualification with the following results:

Major Mathematics:	B
Physics:	B
English:	B
Chemistry:	B

Students with strong backgrounds in mathematics are given preference.

STAT_P Test Score is a requirement for School Leavers (SL)

School leavers apply through the normal School Leavers Form (SLF) applications while non-school leavers apply directly through the Admissions Office of the University.

Tentatively accepted non-school leavers are required to sit for an entrance examination. The final admission into the program will depend on their performance on the entrance examination (minimum average score of 70%). The entrance examination consists of similar questions for grade 12 examinations on the core subjects, such as Major Mathematics, Physics, English, and Chemistry.

MASTER OF ENGINEERING (MEng)

This is a post-graduate degree course of two to three years duration. It is composed of coursework and a minor dissertation.

The overall objective is to further develop practicing engineers in industry and government bodies, and also assistant lecturers who would eventually take up teaching positions in this university. The program is intended to function with cooperation from overseas universities, which would also moderate the curriculum, dissertation, and examinations.

The program has also built-in flexibility in that those undertaking the course need not leave their place of employment for more than four to six weeks in a year. The program also provides

incentives to the industry in that the selection of dissertation topics is chosen jointly by employers and university staff, the aim being to assist in the solution of specific industrial problems.

MASTER OF PHILOSOPHY (MPhil)

The MPhil degree program is research-based to be undertaken over a two-year full-time period. Part-time study arrangement is also possible.

To gain entry, candidates must have a good Bachelor of Engineering degree. Normally some work experience in a relevant area is also expected. Supervision is available in all the research areas listed under Research, Development, and Services below.

The University offers a number of Post-graduate Scholarships with substantial stipends, and all eligible post-graduate students may apply.

DOCTOR OF PHILOSOPHY (Ph.D.)

To gain entry into the Ph.D. program, candidates must have a good Master of Engineering degree, preferably in mechanical engineering. Normally some work experience in a relevant area is also expected. Supervision is available in all the research areas listed under Research, Development, and Services below. The normal duration for the Ph.D. program is a minimum of three years of full-time study. Part-time study is also allowed.

The University offers a number of Scholarships with substantial stipends, and all eligible post-graduate students may apply.

FACILITIES

The Department's laboratories have been updated with new equipment with a large range of teaching, research, and test equipment in the fields of heat engines and vehicle technology, engineering materials science, applied dynamics and machine elements, heat transfer and combustion, refrigeration and air conditioning, flexible manufacturing, metrology, solar energy, fluid power, and fluid flow, and non-destructive testing (NDT). In addition, there are extensive facilities for teaching workshop technology, and for the manufacture of specialized equipment, including both vertical and horizontal CNC machine centers, and an EDM machine. CAD (computer-aided design) facilities are also available.

RESEARCH, DEVELOPMENT, AND SERVICES

There are several active research and development projects in the Department, centered on problems of special interest in Papua New Guinea, including the development of low-cost solar heating systems, and solar-powered systems for water pumping and space cooling. Other projects include structural vibration analysis, vibration monitoring in machine maintenance, applications to transport and farm machinery, and the development of low-cost water wheels for hydropower.

The staffs of the department are willing to offer services to the industry in the form of consultancy, personnel training, and short courses on selected topics. The areas of involvement may comprise rural development including the mechanization of agricultural production,

materials testing, solar energy applications, alternative fuels, and renewable energy sources, including charcoal and pyrolytic liquid fuels, wind power, hydropower, production systems including manufacturing processes, plant layout, materials handling, warehouse design and operations, production planning and control, and computer-aided design and drafting.

DEPARTMENT INDUSTRY ADVISORY COMMITTEE (DIAC)

A Department Industry Advisory Committee (DIAC) has been operative since 1994. Composed of senior executives and engineers from industry and government departments employing mechanical engineering graduates, and university staff, the Committee meets occasionally to review and upgrade the curriculum and to deliberate on other matters within the context of the Terms of Reference. It will in particular peruse course details to ensure their relevance to the changing needs of Papua New Guinea and the region.

COURSE STRUCTURE

BACHELOR OF ENGINEERING IN MECHANICAL ENGINEERING

First Year First Semester

Code	Subject	Contact Hours	Credit
EN111	Engineering Practice and Sustainability	6	18
EN112	Engineering Maths-I	6	22
EN113	Engineering Materials and Properties	6	18
EN114	Engineering Computation	6	18
		24	**76**

First Year Second Semester

Code	Subject	Contact Hours	Credit
EN121	Engineering Maths-II	6	22
EN122	Engineering Mechanics	6	18
EN123	Introduction to Circuits and Electricity	6	19
EN124	Introduction to Engineering Design	6	15
		24	**74**

Second Year First Semester

Code	Subject	Contact Hours	Credit
EN211	CAD	6	18
EN212	Engineering Maths-III	6	18
ME211	Basic Thermodynamics and Cycles	6	20
ME212	Numerical Methods	6	18
		24	**74**

Second Year Second Semester

Code	Subject	Contact Hours	Credit
EN221	Engineering Modelling	6	18
ME221	Thermal Power and Systems	6	20
ME222	Solid Mechanics	6	18
ME223	Fluid Mechanics	6	18
		24	**74**

Third Year First Semester

Code	Subject	Contact Hours	Credit
ME311	Mechanics of Machines	6	20
ME312	Machine Design	6	20
ME313	Heat Transfer	6	20
ME314	Manufacturing Processes and Design	6	20
		24	**80**

Third Year Second Semester

Code	Subject	Contact Hours	Credit
EN321	Project Management and Economics	6	20
ME321	Vibration Analysis	6	20
ME322	Metal Cutting and Tools	6	20
*ME323	Introduction to Finite Elements	6	18
*ME324	Non-Destructive Testing (NDT)	6	20
		24	**98**

Fourth Year First Semester

Code	Subject	Contact Hours	Credit
EN411	Research Project A	6	20
ME411	Operations Management	6	20
ME412	Control Engineering	6	20
*ME413	Automotive Engineering	6	20
*ME414	Flexible Manufacturing Systems (FMS)	6	20
		24	**100**

Fourth Year Second Semester

Code	Subject	Contact Hours	Credit
EN421	Research Project B	6	20
ME421	Introduction to Mechatronics	6	20
ME422	Integrated Mechanical Design	6	18

*ME423	Energy and Environment	6	20
*ME424	Failure Analysis	6	20
**EN000	Professional Work Experience (PWE)	0	0
		24	**98**

NOTE:

***:** Elective Subjects

******EN000: Professional Work experience (PWE) in the industry -Work-integrated Learning will be Started in 2nd year and ends in 4th year. This subject will not have any credit points and will be assessed with pass/fail.

Graduate Statement (GS)

The mechanical engineering graduate will have the skills and ability to systematically apply engineering knowledge in an ethical and morally responsible manner in providing practical and sustainable solutions to engineering problems while upholding a level of sensitivity to social, cultural, legal, and environmental issues in society.

Course Learning Outcomes (CLOs)

On completion of the course the student will:

	Course Learning Outcome
CLO1	Possession of a deep understanding of the sciences, math, information systems, and engineering fundamentals that underpin the mechanical engineering discipline.
CLO2	An in-depth understanding of the body of knowledge that forms the mechanical engineering discipline.
CLO3	Collection, synthesis, and application of information within the mechanical and related engineering disciplines.
CLO4	Undertaking research, analysis & evaluation of ideas and concepts within mechanical engineering.
CLO5	Applying problem-solving skills to complex mechanical engineering systems and processes.
CLO6	Undertake mechanical engineering design and manage engineering projects.
CLO7	Communication via multiple media to diverse audiences, undertaking team roles, teamwork, and providing team leadership.
CLO8	Behaving in an ethical and professional manner and respecting others.
CLO9	Being cognizant of the importance of sustainability and the environmental impact of engineering.

Course(s)	Common to all Bachelor of Engineering (NQF level 8)
Subject Name	Engineering Practice and Sustainability
Subject Code	EN111
Duration	13 Lecture Weeks, 1 Exam Week, 1 Mid-Semester Week
Contact Hours	6 hours per week (2 Lectures, 2 Tutorial, 2 Project)
Credit Points	18
Delivery Mode	On Campus
Prerequisites	Nil
Corequisites	Nil
Coordinator	TBA

Synopsis

This subject provides students with an overarching introduction to the broad elements of professional engineering practice and their core competencies. The role of the engineers in society is explored along with the social, political and economic issues that may influence the role. The subject adopts a problem-based learning approach where student teams review a hypothetical engineering case study involving multiple, ethical and environmental related issues to critically analyze possible outcomes. Findings are presented via progressive and final reports culminating in a team work presentation to allow students to demonstrate attainment of good communication skills.

Subject Themes/Topics

Topic	Themes	Topic Details
1	Introduction to professional conducts and ethical engineering practices	a) Role of Engineering in development context b) Engineering ethics and Society
2	Team Building in Engineering Teams	a) Effective Communication b) Assertive Listening c) Critical Thinking d) Organizational Communication
3	Theories of Development	a) Sociological Theory b) Psychological Theory c) Other relevant theories
4	Social Change & Technology in economic and political context of society	a) Social Change b) Technology Change
5	Sustainable engineering practice in social, economic and political contexts.	a) Principle of Sustainability b) Environmental Sustainability c) Engineering Economics & Development
6	The role of media communication in an Engineers' world	a) Role of Media Communication b) Engineers in the real world c) Subject summary

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Demonstrate various concepts of professional and ethical conducts and practices in this contemporary engineering and development context.
2. Demonstrate team building, relationship and stakeholder engagement behaviors in engineering and development problem solving situations.
3. Research the range of environmental, technical and social elements involved in engineering challenges.
4. Apply skills in accessing, evaluating and summarizing information to communicate ideas and present arguments individual and within teams.
5. Apply a variety of Engineering Practices and strategies to meet engineering needs in complex social, political and economic environments.
6. Investigate, analyses and use a range of communication skills (speaking, writing, drawing and listening); and select and apply appropriate channels of communication in the sustainability process individually and within teams.

Assessment Tasks and Weightings – 100% Continuous

There is no final examination in this Subject. To pass these subject students must obtain 50% overall and a minimum of 40% in the Major Project Report.

Assessment Type	**Mark (%)**
Assessment 1: A Short Paper (concept understanding)	30
Assessment 2: A Short Test	15
Assessment 3: Major Project Report	40
Assessment 4: Problem-Based Project (Practical Application)	25

Students must also refer to the Subject Assessment Details

Assessment 1 – A Short Essay Paper: A concept based short essay paper outlining the students' understanding of general concepts, definitions and explanations relevant to the themes within Topics 1 & 2 covered in the lectures. The paper relates to professional conducts and ethical practices, their role in society and team building. The essay contributes 20% towards the final grade for the subject.

Assessment 2 – A Short Test: A concept based closed book assessment, testing students' abilities and comprehensions of the various concepts covered in the Topics. The test contributes 15% towards the final grade for the subject.

Assessment 3 – Major Project Report: A professional engineering structured report with individual and team components that outlines and communicates the project design/initiation processes, objectives, rationale and outcomes. The Major Project Report contributes 40% towards the final grade for the subject.

Assessment 4 – Problem-Based Project: A group professional report on resolving contemporary engineering associated issues prevalent in PNG. All team members will contribute and grades will be as function of team and individual performance. The presentation contributes 25% towards the final grade for the subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 13-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

No specific Text

References

1. William E. Kelly, Ph.D., P.E.; Barbara Luke, Ph.D., P.E., D.GE; and Richard N. Wring, Ph.D., (2017). Engineering for Sustainable Communities, ASCE
2. American Society of Civil Engineers, (2004). Sustainable Engineering Practice: An Introduction.
3. David T. Allen & David R. Shinnard (2011). Sustainable Engineering: Concepts, Design and Case Studies 1st Education
4. Braden R. Allenby, (2011). The Theory and Practice of Sustainable Engineering 1st Edition

Readings and Resources:

Lecture notes and PowerPoints will be uploaded to the Google classroom.

Relevant Unitech Policies

It is important that all students familiarize themselves with the University of Technology Assessment Guidelines including those on plagiarism at www.unitech.ac.pg.

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Engineering Mathematics I
Subject Code	EN112
Duration	13 teaching weeks, 1 exam week, 1 mid-semester week break
Hours	6 (4 hours lectures, 2 hours tutorials)
Credit Points	22
Delivery Mode	On campus
Prerequisites	Nil
Co-requisites	Nil
Coordinator	TBA

Synopsis

The Subject provides students with the fundamental mathematical concepts, principles and analytical processes that underpin all disciplines of Engineering. The topics of functions is important as studying the behavior of systems and limits helps to critically analyze the limitations of systems. Differentiation and integration techniques help to calculate features and characteristics of a system while complex numbers help to represent systems where the natural numbers cannot adequately cater.

Subject Topics

1. **Functions & Limits:** Functions: Types of functions; Composition of functions; Inverse functions; Logarithmic and exponential functions; Trigonometric and hyperbolic functions; Inverse trigonometric and hyperbolic functions.
2. **Sequence and Series:** Infinite Series and Processes: Sequences; Partial sums; Tests for convergence of a series of real numbers; Power series; radius and interval of convergence of a power series; Taylor and Maclaurin series.
3. **Differentiation & Applications:** Differentiation: Differentiation by using limits; Techniques of differentiation; Applications of differentiation - maxima and minima, tangents to curves, small increments
4. **Integration & Applications: Integration: Anti-derivatives;** The First and Second Fundamental Theorems of Calculus; Techniques of integration - substitution, by parts; Applications of integration - the area enclosed between two curves, volumes of solids of revolutions.
5. **Complex Numbers:** Cartesian, polar and exponential forms of a complex number; Euler's Formula; De-Moivre's Theorem; Roots of a complex number.
6. **Probability and Statistics:** Introduction to data analysis and applications of Binomial, Poison, normal distributions and chi square distribution in engineering. Use of different statistical techniques such as regression analysis.

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Demonstrate a clear understanding of trigonometric, logarithmic, exponential and hyperbolic functions, and their inverses.
2. Test series for convergence, and find radii and intervals of convergence of power series.
3. Apply the techniques of differentiation to solve problems involving maxima and minima and related rates.

4. Use integration to find areas enclosed between curves, and volumes of solids of revolution.
5. Solve problems involving complex numbers.
6. Apply probability and statistics in solving engineering problems and analysing data

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and at least 50% achieved in the final examination.

Unit Assessment consists of three assignments, three tests and a final examination as summarized below. Students must also refer to the Assignments, Tests and the Subject Assessment Guide for Engineering Mathematics I where detailed information is provided for each assignment.

AT1: Assignment 1 The assignment provides student with the opportunity to evaluate and critically analyses different types of functions and series. It contributes 10% of the total marks for the Subject.

AT2: Test 1 The test provides student with the opportunity to recall, interpret and solve problems involving functions and sequences and series. It contributes 10% of the total marks for the Subject.

AT3: Assignment 2 This assignment involves selecting and evaluating the techniques of differentiation and techniques of integration to solve application problems. The assignment is worth 10% of the total marks for the Subject

AT4: Test 2 The test provides student with the opportunity to recall, interpret and solve problems involving differentiation and integration. It contributes 5% of the total marks for the Subject.

AT5: Assignment 3 This assignment involves solving problems using complex numbers. The assignment is worth 10% of the total marks for the Subject.

AT6: Test 3 The test provides student with the opportunity to recall, interpret and solve problems involving complex numbers. It contributes 5% of the total marks for the Subject.

AT7: Final Examination: The final examination is of 3 hours duration. The final exam is worth 50% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Stroud K.A .Engineering Mathematics: Programs and Problems. 6th Edition (ELBS/Macmillan 2000)
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999)
3.

References

1. Kreyszig E, Advanced Engineering Mathematics, 7th Edition Wiley, 1999.
2.

Readings and Resources

Scientific Calculator: student to provide
Weekly Tutorial worksheets

Mathematical software

Relevant Unitech Policies

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Engineering Materials and Properties
Subject Code	EN113
Duration	One semester
Contact Hours	6 Hours (3 Lectures + 3 practical)
Credit Points	18
Delivery Mode	On campus
Prerequisites	Nil
Co-requisites	Nil

Synopsis

Engineering Materials and Properties provides students with the opportunity to attain a fundamental knowledge of materials used in the different fields of engineering. It will impart cognitive skills to think critically about the materials relevant for industrial and domestic applications. The subject examines the physicochemical properties of materials and how they impact on their design and applications in engineering. The materials studied cover the broad spectrum from hydrocarbons through to metals, lubricants, cements, nanomaterials, polymers and ceramics. The subject adopts a hands-on experimental approach through the use of laboratory practical sessions that enhance the theoretical concepts.

Subject Topics

1. Topic 1: Structure of Solids
2. Topic 2: Mechanical Properties of Materials
3. Topic 3: Equilibrium Diagrams
4. Topic 4: Electrical and Magnetic Materials
5. Topic 5: Corrosion Processes
6. Topic 6: Material Selection

1. Structure of solids: Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

2. Mechanical properties of materials: Elastic, Inelastic and Viscoelastic behavior, Engineering stress and engineering strain relationship, true stress - true strain relationship, review of mechanical properties including tensile, bending and shear.

3. Equilibrium diagrams: Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagrams, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

4. Electrical and magnetic materials: Conducting and resistor materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric

materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.
5. Corrosion process: Corrosion, Causes of corrosion, Types of corrosion, Protection against corrosion including coatings such as paints and galvanizing.
6. Materials selection: Overview of properties of engineering materials. Selection of materials for different engineering applications.

Subject Learning Outcomes

After completing this Subject, students will be able to:

1. Demonstrate fundamental knowledge of the structures of solids and their analysis.
2. Demonstrate how to assess the mechanical properties of different materials to determine their uses for various engineering disciplines.
3. Appy equilibrium diagrams relevant to the various engineering disciplines to discern alloying outcomes.
4. Achieve the capacity to investigate and evaluate the properties of Electrical and Magnetic materials for engineering applications.
5. Undertake the selection of materials for engineering tasks based on non-dimensional analysis based on a wide strictum of parameters such as tensile, bending and shear strength, resistivity and corrosion resistance.
6. Develop teamwork and communication skills by participating in laboratory practical sessions and writing reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject, 50% overall must be achieved. Formative assessments will contribute 50% and summative final written examination will contribute 50% to overall assessment**.**
Subject Assessment consists of assignments, laboratory practicals and a final examination as summarized below. Students must also refer to the Assignments and the Subject Assessment Guide for Engineering Materials and Properties where detailed information is provided for each assessment.

1. **Assignment 1 (team) -** The assignment provides student with the opportunity to undertake a critical analysis of engineering materials. It contributes **5%** of the total marks for the Subject.
2. **Test -** There will be 2 tests. They contribute **20%** of the total marks for the Subject.
3. **Laboratory Sessions (team) –** Group experimental work contributes **25%** of the total marks for the Subject.
4. **Final Examination:** The final examination is of 2 hours duration consisting of two parts. Part A is compulsory. Part B consists of a selection. The final exam is worth **50%** of the total marks for the Subject.

Student Workload

The total workload for the subject for the ‘average’ student is a nominal 150 hours, based on a 15-week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Text books

1. W.D. Callister, Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008

Reference Textbooks

1. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.
2. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.
3. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.
4. K. G. Budinski, Engineering Materials – Properties and selection, Prentice Hall India, 1996.

Web references:

- www.tndte.com
- nptel.ac.in/downloads
- www.scribd.com
- cuiet.info
- www.sbtebihar.gov.in

Relevant Unitech Policies:

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Engineering Computations
Subject Code	EN114
Duration	13 teaching weeks, 1 exam week, 1 mid semester break week
Contact Hours	6 (4 Lectures, 2 Laboratories)
Credit Points	18
Delivery Mode	On campus
Prerequisites	Nil
Co-requisites	Nil
Course Coordinator	TBA

Synopsis

The subject introduces student to engineering problem solving though the use of computer-aided engineering software with a strong emphasis on data collection and analysis tools. It explores the use of Excel, Matlab and SAP JMP as a tool to import, cleanse, analyze, manipulate and reporting of engineering data. Data science methodology are implemented through the use of the Excel VBA framework, Matlab scripts of the Matlab computational software and the JMP programming language of SAS JMP - emphasis on the trade-off between efficiency and accuracy of computational methods versus algebraic analytical methods.

Subject Topics

1. **Introduces Excel as data handling tool in engineering**
   - 1.1. Explores the use of formulae on data manipulation using the coordinate system of data cells
   - 1.2. Explores the use of charting functions on data collections
   - 1.3. Introduces the grammar of the VBA language and uses it to develop automation on data manipulation
   - 1.4. Data cleansing process of data importation and data massage into a form that can be manipulated and analyzed
   - 1.5. Implement modeling methods using formulae and VBA including; Statistical Analysis, Time Series Analysis, Mathematical functions, Curve Fitting and Regression and Solving Equations
   - 1.6. Numerically differentiating, integrating and integration of differential equations for engineering applications.

2. **Introduces Matlab as a computational tool for engineering applications**
   - 2.1. Matlab fundamentals: Matlab interface, Matlab data types, Matlab script and function files.
   - 2.2. Matlab programming: Loop Commands, Logical Branching Statements, Combining Loops and Logic, elementary vectorisation of algorithms
   - 2.3. Matlab Data Plotting

2.4. Matlab Engineering Applications: Finding Roots of Equations, Matrix Mathematics, Solving Simultaneous Equations, Numerical Integration, Solving Ordinary Differential Equations, Solving Partial Differential Equations, Solving Nonlinear Algebraic Equations.

3. **Introduces JMP SAS for engineering data analytics.**
   3.1. Data: Importing Data into JMP, JMP Data Table, Cleaning and Formatting Data, Analyzing Row States.
   3.2. Index of Graphs: Basic Charts, Thematic Maps, Graphs of One, Two and Multiple Columns.
   3.3. Graphing: Using Graph Builder to produce graphs of Data and Maps.
   3.4. Problem Solving with One, Two and Multiple Columns.

Subject Learning Outcomes (SLOs):

On completion of this subject, the students will be able to:

1. Demonstrate qualitative and quantitative understanding of the use of Excel Spreadsheet.
2. Develop a working knowledge of the required mathematical solution procedures for engineering analysis.
3. Illustrate the use of spreadsheets to compute a variety of engineering problems.
4. Apply Excel built-in features and VBA, Matlab and SAP JMP to compute engineering problems.
5. Apply necessary skills to design and implement an emerging engineering application.

Assessment Tasks and Weightings:

To obtain a pass grade in this subject a student must achieve 50% overall. There is no final examination for this subject. Students must also refer to the *Subject Assessment Details* as prescribed by the subject coordinator.

Computer Laboratory Reports and Quizzes are worth 40% of the overall marks for the subject. Assignments and Projects are worth 40% and Tests are worth 20%.

Subject Assessment Task (AT) Details

AT Item	Component	Marks	Week(s)
1. Laboratory	**Lab 01**	**3 %**	**03**
	Lab 02	**3 %**	**04**
	Lab 03	**3 %**	**05**
	Lab 04	**3 %**	**06**
	Lab 05	**3 %**	**07**
	Lab 06	**3 %**	**08**
	Lab 07	**3 %**	**09**
	Lab 08	**3 %**	**10**
	Lab 09	**3 %**	**11**
	Lab 10	**3 %**	**12**
2. Quizzes	**Quiz 01**	**5 %**	**05**
	Quiz 02	**10 %**	**08**
	Quiz 03	**10 %**	**11**
3. Assignments	**Assignment 01**	**5 %**	**3 - 6**
	Assignment 02	**5 %**	**7 - 9**
	Assignment 03	**10 %**	**9 – 12**
4. Test	**End-Semester Practical Test**	**10 %**	**07**
	Mid-Semester Practical Test	**15 %**	**13**

Student Workload:

The total workload for the subject for the 'average' student is a nominal 140 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Textbooks:

- Ronald Larsen - Engineering with Excel, Pearson, 2012
- Svein Linge & Hans Petter Langtangen - Programming for Computations – MATLAB/Octave, 2010
- JMP ® Essentials An Illustrated Guide for New Users, 2nd Edition, 2012

References:

- Bill Jelen - VBA and Macros Microsoft Excel 2010, Que Publishing, 2010
- Joseph C. Musto, William E. Howard & Richard R. Williams – Engineering Computations: An Introduction Using Matlab and Excel, 2009.

Readings and resources:

https://www.youtube.com/watch?v=T_ekAD7U-wU
https://www.jmp.com/en_us/home.html
https://www.youtube.com/watch?v=AKsj0sxCtFA&list=PL3mwk0Db0keIwDJopA_rRD1aTXT92PLE6
https://www.youtube.com/watch?v=xge-f1KV_oc&list=PL411D719858B57C47

Relevant University Policies:

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Engineering Mathematics 2
Subject Code	EN121
Duration	13 teaching weeks, 1 exam and 1 mid semester week break
Hours	6 (4 hours lectures, 2 hours tutorials)
Credit Points	22
Delivery Mode	On campus
Prerequisites	EN112 Engineering Mathematics I
Co requisites	Nil

Synopsis

This subject will continue to develop the fundamental mathematical concepts, principles and analytical processes that underpin professional Engineering studies. The topic of vectors expands mathematics concepts into 2D and 3D space and matrices helps to represent and solve systems of linear equations. The topics of Differential equations first and second order helps to model dynamic systems and teaches techniques to solve related problems and Laplace Transform as an adequate mathematical tool in solving differential equations.

Subject Topics

1. **Vectors:** Dot product; Cross product; scalar triple product; parametric equations of a line; planes in 3-space.
2. **Matrices:** Addition and multiplication of matrices; Systems of linear equations; Gauss elimination; Determinants; Inverses; Cramer's Rule.
3. **First Order ODE**: Techniques of solving 1st ODE: Separation of variables, Homogeneous equations, Integrating factor, Transformation, Bernoulli Equations, Exact differential equations, Solutions by substitution. Applications of ODE – bacterial growth, half-life of radioactive matter, cooling and heating, current flow in series circuit, and concentration of mixtures in tank reservoirs.
4. **Second Order ODE:** Formation, Solution of constant coefficient linear homogeneous and non-homogeneous equations, Method of undetermined coefficients, Applications.
5. **Laplace Transform:** Definition of Laplace Transforms, Transform of standard functions, Table of transforms, Properties of transforms, Laplace inverse transforms. Heavy side functions, Unit functions, Dirac functions, etc. Solving systems of ODEs.

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Solve problems involving the vector equations of lines and planes in 3-D space.
2. Use Cramer's rule and Gauss elimination to solve systems of linear equations, including those with infinitely many solutions, geometric interpretation.
3. Formulate and solve various first order differential equations,
4. Formulate and solve second order linear differential equations with constant coefficients,
5. Use Laplace and inverse Laplace Transforms to solve O.D.E.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and at least 50% achieved in the final examination.

Unit Assessment consists of three assignments, three tests and a final examination as summarized below. Students must also refer to the Assignments, Tests and the Subject Assessment Guide for Engineering Mathematics 2. Detailed information is provided for each assignment.

1. **Assignment 1** The assignment provides student with the opportunity to construct and evaluate vector equations in 2 and 3 dimensions and matrices. It contributes 10% of the total marks for the Subject.
2. **Test 1** The test provides student with the opportunity to recall, interpret and solve problems involving vectors and matrices. It contributes 10% of the total marks for the Subject.
3. **Assignment 2** This assignment provides students with the ability to formulate and solve first order and second order differential equations. The assignment is worth 10% of the total marks for the Subject.
4. **Test 2** The test provides student with the opportunity to recall, interpret and solve problems involving first order and second order DE. It contributes 5% of the total marks for the Subject.
5. **Assignment 3** This assignment provides the students with the ability to apply Laplace transforms. The assignment is worth 10% of the total marks for the Subject.
6. **Test 3** The test provides student with the opportunity to recall, interpret and solve problems involving Laplace Transforms. It contributes 5% of the total marks for the Subject.
7. **Final Examination:** The final examination is of 3 hours duration. The final exam is worth 50% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Stroud K.A. 2000, Engineering Mathematics: Programs and Problems. 6th Edition (ELBS/Macmillan)
2. Anton H,1999, Calculus with Analytical Geometry, 6th Edition (Wiley)

References

1. Kreyszig E1999, Advanced Engineering Mathematics, 7th Edition (Wiley).

Readings and Resources

- Scientific Calculator: student to provide
- Weekly Tutorial worksheets
- Mathematical software

Relevant Unitech Policies

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Engineering Mechanics
Subject Code	EN122
Duration	13 teaching weeks, 1 exam and 1 break week
Contact Hours	6 Hours (3 Lect, + I Tut, + 2 lab)
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN112 Engineering Mathematics I
Co requisites	Nil

Synopsis

The subject of engineering mechanics provides students with the opportunity to attain a knowledge of the fundamental engineering sciences that provide the foundation for all engineering disciplines. The subject incorporates topics from fundamental units of measurement, Rigid body static, Structures, Friction, Center of Gravity and Moment of Inertia, Kinematics of particles, Kinetics of particles, rigid body dynamics and Waves.

Subject Topics

1. **Rigid body static:** Equivalent force system. Equations of equilibrium, Free body diagram, Reaction, Static indeterminacy and partial constraints, Two and three force systems.
2. **Structures:** 2D truss, Method of joints, Method of section. Frame, Beam, types of loading and supports, Shear Force and Bending Moment diagram, relation among load-shear force-bending moment.
3. **Friction:** Dry friction (static and kinematics), wedge friction, disk friction (thrust bearing), belt friction, square threaded screw, journal bearings (Axle friction), Wheel friction, Rolling resistance.
4. **Centre of Gravity and Moment of Inertia:** First and second moment of area and mass, radius of gyration, parallel axis theorem, product of inertia, rotation of axes and principal M. I., Thin plates, M.I. by direct method (integration), composite bodies.
5. **Kinematics and Kinetics of Particles:** Rectilinear motion, curvilinear motion rectangular, normal tangential, polar, cylindrical, spherical (coordinates), relative and constrained motion, space curvilinear motion, Force, mass and acceleration, work and energy, impulse and momentum, impact.
6. **Kinetics of Rigid Bodies:** Translation, fixed axis rotation, general planner motion, work -energy, power, potential energy, impulse-momentum and associated conservation principles, Euler equations of motion and its application.
7. **Waves:** Definitions of wave parameters, types of waves (sound waves, light waves, surface waves), travelling and standing waves and their equations, wave interference.

Subject Learning Outcomes (SLOs)

On completion of this Subject, students will be able to:

1. Explain the basic laws and principles of mechanics.

2. Analyze and solve simple problems in mechanics.
3. Identify the assumptions and limitations of approaches used in calculation of mechanical problems.
4. Apply scalar and vector analytical techniques for analyzing forces in statically determinate structures.
5. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
6. Develop team work attributes and abilities.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and a minimum of 40% must be achieved in the final examination. Students must also refer to the Subject Assessment Task Details.

AT1. Assignments: Individual written assignments contribute 10% to the final marks.
AT2. Laboratories: Group Laboratories contribute 20% to the final marks.
AT3. Class Quizzes: Tests(s) contributes 20% to the final marks.
AT4. Final Examination: The Final Exam contributes 50% to the final mark.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II – Dynamics, 6th Ed, John Wiley, 2008.
F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill, 2011.
Hugh D.Young and Freeman, University Physics 12th Edition,(Pearson, Addison Wesley 2008).

References

I. H. Shames, Engineering Mechanics: Statics and dynamics, 4th Ed, PHI, 2002.
R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006

Readings and Resources

Internet sources
The reading and resources for this subject will depend on the project that is selected for the students to do the design.

Relevant Unitech Policies

It is important that all students familiarize themselves with the PNG Unitech Assessment Guidelines including those on plagiarism. This can be viewed on the PNG Unitech website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Introduction to Circuits and Electronics
Subject Code	EN123
Duration	13 teaching weeks, 1 examination week and 1 mid-semester week
Contact Hours	6 hours per week (3 Lect, 2 Lab, 1 Proj.)
Credit Points	19
Delivery Mode	On campus
Prerequisites	Engineering Mathematics 1
Co requisites	Nil
Subject Coordinator	TBA

Synopsis

Introduction to Circuits and Electronic enables students to attain knowledge of circuits and the integration of electronic components to obtain these circuits. It will impart skills to identify various electronic components, verify their operational characteristics and use them to design circuits which lead to a practical system. It introduces the fundamentals of the lumped circuit abstraction, the basic components of electronics such as resistive elements, diodes, transistors, amplifier and op amps. It examines the different ways to design basic analogue and digital electronic circuits for engineering applications.

Subject Topics

1. **Basic Electronic Principles**
   - 1.1. Ohm's Law
   - 1.2. Semiconductors and Types
   - 1.3. Diodes, Types and Applications
   - 1.4. Transistors, Configuration and Biasing
   - 1.5. Operational Amplifiers

2. **Electronic Instruments**
   - 2.1. Importance and Application of General Purpose Instruments
   - 2.2. Multi-meter
   - 2.3. Cathode-ray Oscilloscope
   - 2.4. Function Generators
   - 2.5. Switched Mode Power Supply (SMPS)
   - 2.6. Inverter and Uninterrupted Power Supply (UPS)

3. **Analog Circuits and Their Applications**
   - 3.1. Diode as Rectifier: Half wave and full wave
   - 3.2. Bridge Rectifier
   - 3.3. Capacitor Filter Circuit
   - 3.4. Zener Diode as Voltage Regulator
   - 3.5. Transistors as Amplifiers
   - 3.6. Inverting and Non-inverting Operational Amplifiers
   - 3.7. Operational Amplifier Applications: Addition, Subtraction, and Voltage Follower

4. **Digital Circuits and Their Applications**
   - 4.1. Number Systems and their Conversion
   - 4.2. Logic Gates: OR, NOT, NOR, AND, NAND
   - 4.3. De Morgan's Theorem
   - 4.4. Algebraic Simplification
   - 4.5. NAND and NOR Implementation
   - 4.6. Half-added and Full-adder Circuits
   - 4.7. Multiplexer and Demultiplexer

5. **Introduction to Integrated Circuits**
   - 5.1. Need of Integrated Circuits
   - 5.2. Classifications of Integrated Circuits
   - 5.3. Fabrication Process

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Analyze the fundamental principles of electronics
2. Employ simple lumped circuit models for resistors, sources, inductors, capacitors, and transistors in circuits.
3. Analyze circuits made up of linear lumped elements.
4. Employ Boolean algebra to describe the function of logic circuits.
5. Construct simple gates, amplifiers, or filters in the laboratory.
6. Design, build and test basic circuits which include both analog and digital components.
7. Develop team skills and communicate experimental and project outcomes

Assessment Tasks and Weightings

To obtain a pass grade in this subject 50% overall must be achieved.

The subject assessment consists of a mini project (30%), five laboratory assignments (30%) and a final examination (40%) as summarized below. Students must also refer to the Subject Assessment Guide for Introduction to Circuits and Electronics. Detailed information is provided for each assignment.

AT1. Mini Project The mini project provides students – working in groups - with the opportunity to undertake industrial project to apply their knowledge acquired in the lectures and tutorials to develop a solution to an industrial problem. This assessment contributes 30 % to the total marks for this subject.

AT2. Laboratories There will be five laboratories to be conducted and assessed. Each laboratory will contribute 5% to the total assessment items mark of 30%. Before the start of each laboratory there will be a 5-minute quiz worth 1% of the 5% mark for each laboratory. The laboratory activities allow the student to prepare a professional level of application design. It involves undertaking an analysis of various circuits and design of minimum of 3 alternative circuits for specific applications.

AT3. Final Examination: The final examination is of 2 hours duration consisting of two parts. The examination consists of Part A which is to evaluate their knowledge and Part B consists of a choice of two questions out of three questions. The final exam is worth 40% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Sean Westcott & Jean Riescher Westcott, *Basic Electronics: Theory and Practice*, Mercury Learning and Information, 2nd Edition, 2018.
2. Anant Agaral & Jeffrey Lang, *Foundations of Analog and Digital Circuits*, Elsevier Morgan Kaufmann, 2005
3. Daniel M. Kaplan & Christopher G. White, *Hands-On Electronics: A Practical Introduction to Analog and Digital Circuits*, Cambridge University Press, 2003

References

1. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory", 8th Ed., Pearson Education India, New Delhi, 2002.
2. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York

Readings and Resources

1. NPTEL Lecture series on basic electronics available at https://nptel.ac.in/courses/117103063/
2. MIT Open courseware on basic electronics available at https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/.

Relevant Unitech Policies

All university policies can be found at http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Introduction to Engineering Design
Subject Code	EN124
Duration	13 teaching weeks, 1 exam and 1 break week
Contact Hours	6 hours per week (2 Lect) + 1 Tut + 3 Proj/Lab)
Credit Points	15
Delivery Mode	On campus
Prerequisites	Nil
Co-requisites	Nil

Synopsis

The subject provides students with the opportunity to develop their engineering design skills, underpinned through the utilisation of a broad range of engineering drafting equipment, media, and reproduction methods including computer-aided design and drafting (CADD). Topics include design elements and components and the application of CADD in the design process. The importance of communication design through drawings, presentations and writing as key steps in solving most engineering problems is stressed. A team based design project is undertaken.

Subject Topics

1. Introduction to engineering design and design teams
2. Design elements and components including design drafting
3. Drafting and reproduction methodologies including sketching applications within engineering design
4. Introduction to Computer-Aided Design and Drafting (CADD) as part of the design process
5. Geometry, views, annotations, dimensioning and tolerancing
6. Producing working design drawing
7. Design specifications

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Identify and apply the various elements and components within an engineering design process.
2. List and describe the key terminology and tools within engineering design drawing.
3. Apply their skills to solve technical problems, and to develop a systematic methodology in engineering design drawing.
4. Outline systematic methodologies within the engineering design process
5. Apply creativity, problem solving, and decision-making techniques in the design process.
6. Display communication, teamwork and leadership skills through active participation

within an engineering design team.

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved plus at least 40% in the Final Design Report. There is no final examination in this subject. Unit Assessment consists of reports, assignments, test and a presentation as summarised below. Students must also refer to the Assignments and the Subject Assessment Guide for detailed information on each assignment.

Assessment Task 1: Project Concept Report. The first assessment task is a Team based report that outlines; team formation, the roles of team members, the process for design project selection, the team action plan and future schedule for meetings. A Gantt chart or its equivalent is required. It is worth 10% of the total marks for the subject.

Assessment Task 2: Two individual written assignments that are each worth 5% and contribute 10% overall to the final marks.

Assessment Task 3: Two class tests/quizzes that are each worth 5% and contribute 10% overall to the final marks.

Assessment Task 4: Design Progress Report. The Team based report outlines the team progress in achieving design outcomes. The report will outline the progress against the schedule provided in assessment task 1 and identify the issues that may have impacted on progress. It is worth 15% of the total marks for the subject.

Assessment Task 5: Final Design Report. The assessment task is comprised of a combination of individual and team-based reports outlining the design processes, issues that may have impact design, design outcomes and recommendations for future work. It is worth 40% of the total marks for the subject.

Assessment Task 6: Team Presentation. The task is a Team audio visual presentation of the Final Design Report, which focusses on design outcomes. Marks will be awarded for Team members and the overall Team. It is worth 15% of the total marks for the subject.

Student Workload

The total workload for the subject is nominally 150 hours, based on a 15-week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

Madsen D.A., Madsen D.P.-Engineering Drawing & Design, 5th Edition, Delmar, Cengage Learning, 2012.

References, Readings and Resources

Engineering Design Process, available at https://www.youtube.com/watch?v=ZQF8iU7ygoM

Introduction to Engineering Design Course, available at https://www.youtube.com/watch?v=sCgGW5XBnGI

Introduction to Engineering Design Process and Stages of Designing, available at

https://www.youtube.com/watch?v=1JQBkU-DtYY

Summer Institute for Engineering and Technology Education, 2001. Introduction to Engineering Design and Problem Solving, available at https://webpages.uncc.edu/~jmconrad/hsed/intr_0in.pdf

Other readings and resources for this subject will depend on the design project selected for students to undertake.

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor Engineering (NQF Level 8)
Subject Name	Computer Aided Design
Subject Code	EN211
Duration	13 Lecture Weeks, 1 Exam Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN114 Engineering Computation EN124 Introduction to Engineering Design
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces students to the modern approach of 3D Computer Aided Design for generating and analysing solid models and assemblies related to Civil, Electrical, Mechanical and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in the creation, modification, analysis, and optimization of engineering design. Also included are topics dealing with the creation of technical drawings, generation of bills of materials and basic elements of static, dynamic and thermal analysis.

Subject Topics

1. **Characteristics of Digital Engineering Documentation**: Characteristics of feature-based, parametric solid modeler. Principal components of modern 3D CAD software user interfaces. Relationships between digitally created sketches, components, assemblies and technical drawings.

2. **Creation of Fully Defined Sketches**: Characteristics of sketch geometry and relationships between geometrical features. Sketch tools. State of the sketch and the creation of fully defined sketches. Design intents function of dimensioning methodologies.

3. **Basic 3D Component Modelling**: Extrusions from sketches. Boss and cut extrusions. Hole wizard, fillets, basic drawings, dimension changes. Associativity between solid models and drawings. Feature parameter editing.

4. **Advanced 3D Component Modelling**: Revolved and sweep features. Shellings and ribs. Patterns. Part configurations, repairs and design changes. Design tables, equations, families of parts. Selection of materials and calculation of physical properties of solid models: mass, center of gravity, moment of inertia. 3D printing.

5. **Creation of Assemblies**: Bottom-up and top-down assemblies. Import of commercial parts. Geometrical, mechanical and advanced mating relationships between parts in assembly. Mass properties and interferences. Creation of exploded views. Bills of materials.

6. **Creation of Technical Drawings for 3D Parts and 3D Assembly Models**: Templates, views, dimensions and tolerances. Sections and technical notes.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Describe the characteristics and requirements of digitally created engineering documentation and the relationships between sketches, parts, assemblies and technical drawings for engineering design.
2. Create fully defined design sketches
3. Execute basic 3D component modelling and understand design intend and associativity between 3D models and technical drawings.
4. Undertake advanced 3D component modelling, implement design changes, assign materials to models and calculate physical properties of models. Use design tables and equations and create families of parts.
5. Create 3D assemblies, add mating relationships between parts, evaluate mass properties and implement changes for interference avoidance. Create exploded views and bills of materials for application in engineering design.
6. Create technical design drawings for parts and assemblies. Add dimensions, tolerances, technical notes, sections and isometric views to created drawings. Prepare parts for 3D printing and 3D print them.

Assessment Tasks and Weightings: **100% Continuous**

To obtain a pass grade in this subject 50% overall must be achieved. There is no final examination for this subject.

Students must also refer to the Subject Assessment Details.

Assessment 1 – Test: Individual computer-based test on Fully Defined Sketch Creation. This test contributes 15% towards the final grade of this subject.

Assessment 2 – Test: Individual computer-based test on 3D Component Modelling. This test contributes 15% towards the final grade of this subject.

Assessment 3 – Assignment: Creation of a 3D Assembly with related Technical Drawings. This assignment contributes 30% towards the final grade of this subject.

Assessment 4 – Assignment: Creation of full Technical Documentation consisting of 3D Modelled Parts, 3D Assembly with Created and Imported Parts, Exploded Views, Bill of Materials and Technical Drawings. This assignment contributes 40% towards the final grade of this subject.

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Textbook

- 3D CAD in SolidWorks – Tutorials

References

- Dassault Systems – *SolidWorks Fundamentals*, Concord, Massachusetts, United States, 2012

Readings and Resources

- Leondes, C. - *Systems Techniques and Computational Methods*, CRC Press, Boca Raton, 2001

Relevant Unitech Policies

- It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are available at the PNGUOT website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor Engineering (NQF Level 8)
Subject Name	Engineering Mathematics III
Subject Code	EN212
Duration	One semester
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN121
Co requisites	Nil
Subject Coordinator	Mathematics Teaching Staff

Synopsis

To enable students to acquire further basic mathematical concepts, principles and analytical processes needed for degree studies in Engineering. On completion of this subject students should be able to use the advanced mathematical method such as Fourier transforms and Laplace transform to solve ordinary and partial differential equations of the 1st and 2nd order

Subject Topics

1. **Topic 1: Numerical Methods**
   - **a.** Solution of equations - bisection, Newton -Raphson. Numerical methods of integration using trapezoidal Rule and Simpson's Rule. Numerical solutions of differential equations using Runge-Kutta technique.

2. **Topic 2: Multivariable Calculus**
   - **a.** Double integrals over rectangular and non-rectangular regions. Triple integrals. Applications including surface areas, centroids, and centre of gravity.

3. **Topic 3: Partial Differential Equations**
   - a. Partial differentiation. Applications including tangent planes, total derivatives, directional derivatives, gradient, maxima/minima. Introduction to partial differential equations.
   - b. Fourier's series, The One Dimensional Wave Equation: The Heat Equation: The Two Dimensional Wave equation:

4. Topic 4: Vector Calculus

c. Inverse square fields, Divergence and curl, The del operator, The Laplacian operator.
d. Evaluation of line integrals in 2D and in 3D space, Change of parameter, Applications to the evaluation of a mass of a wire, arc length and work.
e. The Fundamental theorem of work Integrals, Independence of path, Recognition of conservative vector fields in 2 and 3 dimensional spaces.
f. Finding work using Green's Theorem, Greens Theorem for multiply connected regions.
g. Evaluation of surface integrals, Applications to the evaluation of a mass of a curved lamina, surface area and to vector fields associated with fluid flow and electrostatic forces.
h. Oriented surfaces, using the Divergence Theorem to find flux, Sources and sinks, Gauss's Law for inverse square fields.
i. Relative orientation of curves and surfaces, using Stokes' Law to calculate work, Relationship between Green's Theorem and Stokes' Theorem, Curl viewed as circulation.

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Use numerical techniques to solve equations, calculate definite integrals, and solve differential equations.
2. Find the integral of a function of several variables,
3. Apply Fourier series to solve Ordinary Differential equations and Partial Differential equations.
4. Evaluate line integrals in two and three dimensional space

Assessment Tasks and Weightings

To obtain a pass grade in this Unit 50% overall must be achieved and at least 50% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Unit Assessment consists of three assignments, three tests and a final examination summarised below.

AT1 **Assignment1** The assignment provides student with the opportunity to use numerical techniques to solve equations, calculate definite integrals, and solve differential equations.
It contributes 3% of the total marks for the Subject.

AT2 **Test1** the test provides student with the opportunity to recall, interpret and solve problems involving numerical techniques it contributes 13% of the total marks for the Subject.

AT3 **Assignment2** This assignment provides students with the ability to find the integral of functions of several variables. The assignment is worth 3% of the total marks for the Subject.

AT4 **Test2** the test provides student with the opportunity to recall, interpret and solve problems integral of functions of several variables. It contributes 13% of the total marks for the Subject.

AT5 **Assignment3** This assignment provides the students with the ability to apply Fourier series to solve Ordinary Differential equations and Partial Differential equations. The assignment is worth 4% of the total marks for the Subject.

AT6 **Test3** the test provides student with the opportunity to recall, interpret and solve problems involving Vector Calculus. It contributes 14% of the total marks for the Subject.

AT7 **Final Examination:** The final examination is of 3 hours duration. The final exam is worth 50%of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

1. Kreyszig E. Advanced Engineering Mathematics, 7th ed. (Wiley, 1993).
2. Anton H, Calculus with Analytical Geometry, 6th Edition (Wiley 1999)

References

1. Stroud K.A .Engineering Mathematics: Programmes and Problems. 6th Edition (ELBS/Macmillan 2000)

Readings and Resources

Scientific Calculator: student to provide

Weekly Tutorial worksheets

Mathematical software

Relevant Unitech Policies

- It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are available at the PNGUOT website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Basic Thermodynamics and Cycles
Subject Code	ME211
Duration	13 teaching weeks, 1 exam week and 1 mid semester week
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN121 Engineering Maths II
Co-requisites	Nil
Academic Staff	TBA

Synopsis

The subject enables students to develop their understanding and knowledge regarding gas-liquid-solid transformations and of the relationships between the various physical qualities of substances that are affected by the transformations. Students will study the concepts of heat and work and those properties of systems that are related to energy. The behaviour of fluid as it is compressed, expanded, heated or cooled is investigated. The subject underpins subsequent, more complex studies involving thermal power systems.

Subject Topics

1. Introduction and working fluids
2. First law of thermodynamics
3. Second law of thermodynamics and reversibility
4. The operating principles of internal combustion engines
5. Vapour power cycles
6. Gas power cycles
7. Heat pump and refrigeration cycles

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Solve thermodynamic problems through the application of the basic equations derived from the first law, gas laws and vapour tables.
2. Describe the principles of steam power plant, heat engines and refrigeration systems.
3. Summarise the construction and performance of internal combustion engines.
4. Employ the second law of thermodynamics and the concept of entropy.
5. Workout the basic models to study, analyse and design thermal systems and to comprehend methods to increase the thermal efficiency
6. Work collaboratively in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

The required text for the subject 1.is:

Moran M.J., Shapiro H.N., Boettner D.D. and M.Bailey, Fundamentals of Engineering Thermodynamics, 7th Ed., John Wiley & Sons, 2011.

References

Essential Reference

Eastop, T.D. & McConkey, A., Applied Thermodynamics for Engineering Technologists, 5th Ed., Prentice Hall, 1993.

Readings

Recommended Books and Reference Material

Rogers, G.F.C, & Mayhew, Y.R., Thermodynamic and Transport Properties, 5th Ed., (Basil Blackwell, 1995)

YouTube Clips

The following YouTube Clips should help augment your weekly lectures.

Laws of Thermodynamics at:

https://www.youtube.com/watch?v=KTHiIwxcexI

1st Law of Thermodynamics (experiments) at:

https://www.youtube.com/watch?v=jNPUCmkKiE4

2nd Law of thermodynamics - Principles of Refrigeration at:

https://www.youtube.com/watch?v=dDQgOvmSXCE

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Numerical Methods
Subject Code	ME212
Duration	13 teaching weeks,1 examination week, 1 mid-semester week
Contact Hours	6 hours per week (3 Lect; 2 Tut; 1 Proj)
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN112 and EN121
Co-requisites	EN212
Subject Coordinator	TBA

Synopsis

Numerical Methods enable students to understand and use various numerical techniques and algorithms important for solving engineering problems. The students will be able to get elementary knowledge on errors and types of errors. They will be able to understand, derive and apply various root finding techniques and algorithms to the equation of one variable. They will learn various interpolation techniques using polynomials and hence they will apply them to cubic splines. They will be able to understand numerical differentiation and integration. The students will then be exposed to numerical techniques to solve initial and boundary value ordinary differential equations. The will also be exposed to the algorithms of numerical algebra such as direct and iterative methods for solving linear systems. Finally, they will be introduced to some advanced numerical concepts and algorithms such as eigenvalue problems and approximation theory.

Subject Topics

1. Errors
2. Solutions of equations in one variable
3. Interpolation and polynomial approximation
4. Numerical differentiation and integration
5. Initial value and boundary problems for ODE
6. Direct methods for solving linear systems
7. Iterative Techniques
8. Eigenvalue problems
9. Approximation Theory

Subject Learning Outcomes (SLOs)

On completion of this subject, students should be able to:

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.

2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyze and evaluate the accuracy of common numerical methods applied to different mechanical design and applications.
5. Implement numerical methods in MATLAB or another other related software. Write efficient, well-documented code and present numerical results in an informative way. Learn the basic terminologies and definitions used in the development of concepts, theorems and techniques.
6. Work together with effective communication, professionalism and ethical responsibility in laboratories.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Assignment: The assignments are intended to support students in achieving the learning outcomes for the subject and will contribute 20% towards the final grade for the subject.

Assessment 2 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 3 – Final Exam: The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject.

Assessment 4 – Lab/Project Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Textbook

Richard L. Burden and J. Douglas Faires, Numerical analysis, 9th Ed., Brooks/Cole Cengage Learning, Boston, 2010

References

Steven C. Chapra and Raymond P. Canale, Numerical methods for engineers, 6th Ed., McGraw-Hill Education, New York, 2009.

Readings

Recommended Books and Reference Material

F.B. Hilderbrand, Introduction to Numerical analysis, 2nd Ed., Dover Publications, 1987.

YouTube Clips

The following youtube clips should help augment your weekly lectures.

Solutions of equations in one variable at:

https://www.youtube.com/watch?v=glaCLvm9mxY

Interpolation and polynomial approximation at:

https://www.youtube.com/watch?v=74g5_3TC-tQ

Numerical differentiation and integration at:

https://www.youtube.com/watch?v=mpkfYmnCZJw

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Engineering Modeling
Subject Code	EN221
Duration	13 Lecturing Weeks, 1 Examination Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN 211 Computer Aided Design
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces students to Engineering Modeling and Simulation and offers solutions for engineering analysis and design problems using physics-based computational models. The applications relate to Civil, Electrical, Mechanical and Mining Engineering systems and structures. The included topics address theoretical and practical aspects encountered in model creation, analysis, and optimization of virtual prototypes, with significant cost reduction of the development cycle. Also included are topics dealing with advanced static, dynamic, fluid flow and thermal analysis applied to all fields of engineering and verification problems.

Subject Topics

1. **Specific Features of Engineering Modeling and Simulation**: Engineering modeling and computer simulations as substitutes for prototyping and experiments in a design process. The benefits of evaluating the behaviour of engineering systems by virtual prototyping and simulation. The need for verification problems. Main components of software user interfaces for virtual prototyping and simulation. Steps in creating engineering design models from 3D geometric models.

2. **Fundamental Concepts in Modeling and Simulation**: Stress and strain matrices. Finite Element Method. Vibration modes and buckling of structures. Variational statement and equations of heat transfer. Solutions of transient heat conduction governing equations. Physical capabilities of flow simulations and governing partial differential equations for laminar and turbulent flows. Conjugate and radiation heat transfer. Multi-flows. Boundary conditions.

3. **Static Simulations**: Static analysis of parts, sheet metal and assemblies. Displacement contacts, bolt connectors, remote loads, non-uniform pressure distributions and shrink fits. Beam diagrams and static analysis of trusses. Analysis of systems under bearing loads. Composite shells.

4. **Dynamic and Non-Linear Simulations**: Modal and harmonic analysis. Buckling, drop test and fatigue analysis. Modeling and optimization of systems under combined pressure, thermal and earthquake loads. Non-linear analysis of contacts. Elasto-plasticity modeling and analysis. Random vibrations, thermal contact and thermal stress analysis. Steady-state and transient thermal analysis of electronic components.

5. **Engineering Modeling and Simulations for Thermo-Fluidic Applications**: Structure and interface of flow simulation applied to ball valve design, flow in porous media and conjugate heat transfer. Computational fluid dynamics with mesh optimization in evaluation of hydraulic losses, drag coefficients, non-Newtonian flows and heat exchanger efficiency. Building and electronic cooling simulations.

6. **Validation Applications in Engineering Modeling**: Static, buckling and vibrations verification problems. Unsteady heat conduction and thermoelectric cooling verification problems. Laminar and turbulent flows in pipes.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Describe the benefits of engineering modeling and simulation, the need for verification problems, the modeling software interfaces and the steps in creating engineering models for use in design.
2. Explain the fundamental theoretical concepts in engineering modeling and computer simulation underpinning design related to the fields of statics, dynamics, fluid mechanics and thermodynamics.
3. Perform modeling and static simulation for components and systems encountered in all fields of engineering design.
4. Apply advanced modeling and simulation for components and systems under dynamic and non-linear loading conditions. The gained skills and abilities should cover the large spectrum of all engineering fields.
5. Outline the structure and interface of computational thermo-fluidic applications and perform advanced simulations related to the fields of civil, electrical, mechanical and mining engineering.
6. Undertake simulations for engineering models with known analytical solutions, compare the results, discuss the accuracy of computer modeling and understand its limitations in design processes.

Assessment Tasks and Weightings: **100% Continuous**

To obtain a pass grade in this subject 50% overall must be achieved. There is no final examination for this subject.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Test: Individual computer-based test on Static, Dynamic and Non-Linear Simulations. This test contributes 15% towards the final grade of this subject.

Assessment 2 - Test: Individual computer-based test on Thermo-Fluidic Simulations. This test contributes 15% towards the final grade of this subject.

Assessment 3 - Computer-Based Assignment: Advanced Thermo-Fluidics Simulation. This test contributes 20% towards the final grade of this subject.

Assessment 4 - Computer-Based Assignment: Static, dynamic and non-linear simulation for engineering models with known analytical solutions. This assignment contributes 20% towards the final grade of this subject.

Assessment 5 - Computer-Based Assignment: Thermo-fluidics simulations for engineering models with known analytical solutions. This assignment contributes 30% towards the final grade of this subject.

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Textbook

- Engineering Modeling and Simulation in SolidWorks – Tutorials

References

- Dassault Systems – *SolidWorks Simulation*, Concord, Massachusetts, United States, 2014

- Dassault Systems – *SolidWorks Flow Simulation*, Concord, Massachusetts, United States, 2014

Readings and Resources

- Cook, R. – *Finite Element Modeling for Stress Analysis*, John Wiley & Sons, New York, 1995

Relevant Unitech Policies

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Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Thermal Power and Systems
Subject Code	ME221
Duration	13 teaching weeks, 1 examination week and 1 mid-semester week
Contact Hours	6 hours per week (4 Lec/ 1 Tut/ 1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME211 Basic Thermodynamics and Systems
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

Thermal power and systems enables students to acquire basic knowledge on traditional and non-traditional power plants. Students will gain knowledge on various types of power plants, such as steam, gas turbines, IC engines and hydropower plants. Students will acquire knowledge on power plant components. They will be aware of source of primary energy requirements of power plants such as; fossil (solid, liquid and gaseous fuels), nuclear, renewable/sustainable sources (solar, wind, tidal, geothermal, biomass, biogas). They will be aware of relative advantages of various power plant systems, fuel requirements, environmental pollution and carbon capture methods.

Subject Topics

1. Introduction and economics of power generation
2. Steam Power Plants-Traditional and Non-Traditional Power Plants
3. Gas Turbines
4. IC Engine Power Plants
5. Hydropower Plants and Components

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

7. Discuss economics of power plants
8. Solve problems which require them to apply laws of thermodynamics on various power plant systems
9. Design and recommend improvements for conventional power plants and their components. Conduct team investigations on the feasibility of renewable energy design systems that meet specific energy demands and minimal environmental impact

requirements;

10. Describe fuel requirements for different systems
11. Reflect on the importance of environmental pollution, protocols on controlling pollutions
12. Working in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

Power Plant Engineering, P.K.Nag, 3rd Ed ,2017 Tata McGrraw Hill Publishinh Company

References

Thermal Engineering in Power Systems, Editors: R.S. Amano and B.Sunden, WIT Press 2008

Readings

Specific Journals [Journals e.g. IMechE & EI]

YouTube Clips

https://www.youtube.com/watch?v=IdPTuwKEfmA

https://www.youtube.com/watch?v=uFDb9AQQSgo

https://www.youtube.com/watch?v=lh5_7sHyLU4

Relevant Unitech Policies

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http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Solid Mechanics
Subject Code	ME222
Duration	13 Lecturing Weeks, 1 Examination Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week (3 Lec/ 2 Tut/ 1 Lab)
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN113 – Engineering Materials and Properties
Corequisites	Nil

Synopsis

The subject introduces students to fundamental principles and concepts required in the development, design and analysis of machine components and structures encountered in mechanical engineering. The included topics address theoretical and practical aspects like stress-strain relationships and transformations, Mohr's graphical representations and energy-based methods in evaluating strains. Also included are topics on failure theories for brittle and ductile materials encountered in mechanical engineering design.

Subject Topics

1. **Stress and Strain under Axial Loading Conditions. Hooke's Law**: Stress-strain diagrams, Hooke's Law, Young Modulus, Poisson Ratio. Elastic versus plastic behaviour of materials. The brittle nature of fatigue failure. Component displacements under axial loading.
2. **Torsional Stresses, Strains and Displacements**: Stresses and displacements in shafts. Stress concentrators. Shear modulus. Torsion strains in elastic and plastic ranges. Residual stresses in circular shafts.
3. **Bending Stresses, Strains and Displacements**: Elastic and plastic deformations in beams under bending loads. Stress concentrators. Bending stresses in composite materials. Residual stresses due to bending loads. Eccentric loadings in beams. Bending loadings in curved beams. Analysis and design of beams under bending loads.
4. **Shear Stresses in Beams and Thin-Walled Components**: Shear stresses on horizontal faces of beams. Longitudinal shear stresses on beams of arbitrary shape and thin-walled components.

5. **Stress and Strain Transformations**: General state of stress. Mohr's Circle in 2D and 3D spaces. Principal stresses and maximum shearing stress. Yield and fracture criteria under plane stress. Measurement of strains. Strain rosettes. Principal stresses under given and combined loadings.

6. **Deflection of Beams. Stability of Columns. Energy Methods in Solid Mechanics**: Deformation of beams and the equation of elastic curve. Statically indeterminate beams. Moment-area theorems and maximum deflections of beams. Euler's formula for columns with various end conditions. Eccentric loadings and secant formula. Strain energy and strain energy density. Impact loading. Work-energy methods for evaluating deflections. Castigliano's theorem.

Subject Learning Outcomes (SLOs)

On completion of this subject, students will be able to:

1. Demonstrate an understanding of the concepts of stress and strain, and the stress-strain relationships for homogenous, isotropic materials.
2. Demonstrate an understanding of the relationships between loads, member forces and deformations and material stresses and strains in structural members under axial loading, torsion, flexural loadings, shear, and thin-walled pressure vessels.
3. Demonstrate an understanding of beams, columns and different structures to failure under complex stress states subjected to combined loadings.
4. Apply the above understanding to the designs and analysis of structural members based on strength and deformation criteria and also design a structural component including the concept of factor of safety.
5. Demonstrate an understanding of the assumptions and limitations of the theories used in mechanics of materials.
6. Evaluate and apply the above understanding in different steps of designing process for different mechanical structures/parts such as problem identification, formulation and solution, and resolving critical issues.
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings:

To obtain a pass grade in this Subject at least 50% overall and at least 40% for the Final Examination must be achieved.

Students must also refer to the Subject Assessment Details:

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. **Students must also refer to the Subject Assessment Details.**

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member

roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with 13 weeks of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Text

- Solid Mechanics - *Lecture Notes, Tutorials and Laboratory Guides*

References

- Beer, F., Johnston, R., DeWolf, J., Mazurek, D. – *Mechanics of Materials*, McGraw Hill, New York, United States, 2012

Readings

- Hearn, E. – *Mechanics of Materials*, Butterworth Heinemann, Oxford, Massachusetts, United States, 2000

YouTube Clips

1. https://www.youtube.com/watch?v=B9lyGZzb_6M&list=PLVUFoQtXVwBQPCbgN74CANsyvIogzpCvI
2. https://www.youtube.com/watch?v=VHp3OHO4OKw
3. https://www.youtube.com/watch?v=geqRGNIZGq8&list=PL9RcWoqXmzaLlfmNg2Ku1SdZtvXnYrLbc

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Fluid Mechanics
Subject Code	ME223
Duration	13 teaching weeks, plus 1 examination week and 1 mid-semester week
Contact Hours	6 hours per week (3 Lect; 2 Tut; 1 Lab)
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN112, EN121 and EN212
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

Fluid Mechanics enables students to develop their understanding of fluids, fluid statics and fluid dynamics. In this course, students will study the basic fluid properties and derive the basic formulations of fluid statics applicable to manometers, submerged bodies, buoyancy and stability. The subject covers fluid kinematics and Lagrangian and Eulerian views in fluid mechanics. Students will be introduced to the integral approach in fluid mechanics to derive Reynolds transport theorem and apply it to mass conservation, linear momentum and angular momentum. They will derive Bernoulli equation and apply it to the measurement of pressure in viscid and incompressible flow and understand and analyse the flow behaviour in laminar and turbulent pipe flows. The subject includes the concepts of basic boundary layer theory and the experimental method of experimental fluid mechanics via dimensional analysis and theory of similitude and modelling.

Subject Topics

1. Fluid Properties
2. Fluid Statics
3. Fluid kinematics
4. Control volume approach
5. Bernoulli equations and its applications
6. Pipe flow
7. Flow over immersed bodies
8. Dimensional analysis, similitude, and modelling

Subject Learning Outcomes

On completion of this subject, students should be able to:

1. Describe the basic terminologies used in the development of concepts of fluid mechanics

2. Outline the main concepts, governing principles, and techniques of fluid mechanics involved
3. Apply the concepts, governing principles and techniques to solve fluid problems
4. Analyze, synthesize, evaluate and design fluid problems
5. Work together with effective communication, professionalism and ethical responsibility

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Assignment: The assignments are intended to support students achieving the learning outcomes for the subject and will contribute 20% towards the final grade for the subject.

Assessment 2 – Class Test: The Test contributes 30% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 3 – Final Exam: The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject.

Assessment 4 – Lab Report: A team based or individual lab report outlining individual or team formation. Team based report outlining formation and member roles, team and member action plan. The report contributes 10% towards the final grade for the subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Textbook

Pritchard and Leylegian, *Introduction to Fluid Mechanics*, 8th Ed., John Wiley & Sons Inc., New Jersey, 2011.

References

Munson, Young, Okiishi, and Huebsch, *Fundamentals of fluid mechanics*, 6th Ed., John Wiley & Sons Inc., New Jersey, 2009.

Readings

Recommended Books and Reference Material

Frank M. White, Fluid Mechanics, 7th Ed., McGraw Hill Companies, Inc., New York, 2011.

YouTube Clips

The following youtube clips should help augment your weekly lectures.

Path line, streak line and stream line at:

https://www.youtube.com/watch?v=PtWz4p-WnL8

Reynolds Transport Theorem at:

https://www.youtube.com/watch?v=kUGxaPafeRA

Boundary Layer theory at:

https://www.youtube.com/watch?v=5oVG1MVKHgoE

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Mechanics of Machines
Subject Code	ME311
Duration	13 Teaching Weeks, 1 Examination Week, 1 Mid Semester Week
Contact Hours	6 Hours/Week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME222 – Solid Mechanics
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces the students to the study of relative motion between the various parts of a machine and forces which act on them. The knowledge of this subject is essential for mechanical engineers in designing the various parts of machines. The included topics address various aspects of kinematics, dynamics, kinetics and statics in machinery.

Subject Topics

1. **Kinematics of Motion**: Rectilinear, Curvilinear and Plane Motions. Equations of Motion. Displacements, Velocities and Accelerations.
2. **Kinetics of Motion**: Newton's laws of motion. Mass, momentum, couple. Centripetal and centrifugal forces. Mass moment of inertia, angular momentum. Torque, work, energy and power in mechanical engineering systems. Conservation of energy. Elastic and plastic impacts.
3. **Harmonic Motion**: Displacements, velocities and accelerations in harmonic motion. Governing differential equations. Simple, compound and torsional pendulums. Centers of percussion.
4. **Mechanisms with Lower Pairs**: Pantographs, straight line mechanisms, steering gear mechanisms, Hook's joints. Friction in mechanisms. Solid, mixed and fluid friction. Clutches.
5. **Belts, Ropes, Chains, Gear Drives, Flywheels, Gyroscopes and their Design**: Geometry, materials and characteristics of mechanisms with belt, rope, chain and gear drives. Gear Trains. Energy storage in flywheels. Precessional angular motion and gyroscopic couples.

6. **Governors, Brakes, Dynamometers and Cams**: Hartnell, Proell and Porter governors. Sensitiveness and stability of governors. Types of Brakes. Absorption and torsion dynamometers. Cam-follower mechanisms. Equation of motion, velocities and accelerations in cam-follower mechanisms.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Establish equations of motion for rectilinear, curvilinear and plane motions and evaluate displacements, velocities and acceleration by analytical and graphical methods in mechanism elements in plane motion.
2. Perform quantitative kinetic evaluations on mechanisms by using Newton's laws and principle of conservation of energy.
3. Establish governing differential equation for harmonic motion, evaluate solutions and variation of specific vibration parameters. Design pendulums and calculate centers of percussion.
4. Evaluate and design mechanisms with lower pairs. Evaluate effects of friction on mechanisms and calculate mechanism efficiencies.
5. Evaluate and design mechanisms with belt, rope, chains and gear trains. Evaluate energy storage capabilities of flywheels. Evaluate precessional angular motion, design gyroscopes and calculate their coupling capabilities.
6. Establish governing equations of motion in governors, brakes and mechanisms with cams. Study the velocity and acceleration distributions by analytical and graphical methods.
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15-week semester with 13 weeks of lecturing and laboratories as per the PNG National Qualification Framework.

Subject Text

Norton, R. - Design of Machinery, McGraw Hill, Boston, 2004

References

Myszka, D. – *Theory of Machines and Mechanisms*, Prentice Hall, Boston, 2012

Readings and Resources

Vinogradov, O. – *Fundamentals of Machines and Mechanisms*, CRC Press, London, 2000

YouTube Clips

1. https://www.youtube.com/watch?v=MJeRFzs4oRU&list=PLBEA57F7E7560C8E8
2. https://www.youtube.com/watch?v=Co4YlavCpeQ
3. https://www.youtube.com/watch?v=0uQAPnaW5D4&list=PLWPirh4EWFpEECWjyAysIZ6WIkwHUy72R

Relevant Unitech Policies:

It is important that all students familiarize themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies can be viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies.

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Machine Design
Subject Code	ME312
Duration	13 Teaching Weeks, 1 Examination Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME222 – Solid Mechanics
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces students to the broad perspective of engineering concepts and skills required in the design and analysis of machine components encountered in mechanical engineering. The included topics address theoretical and practical aspects like selection of materials, evaluation of stresses, strains and displacements under static and dynamic loads, surface damage due to erosion and corrosion or failure theories and failure prevention. Also included are topics on developing and designing shafts, elastic elements, bearings and gears. Of significant importance are topics related to the design of fasteners, clutches, brakes, power screws, belts and chains.

Subject Topics

1. **Load Analysis, Selection of Materials and Failure Theories in Mechanical Engineering. Fatigue and Corrosion**: Static and dynamic loading of components in machine design. Elements of contact mechanics. Fracture mechanics. Maximum normal stress, shear stress and Mohr failure theories. Safety factors, reliability and machinability. Failure prevention. Fatigue strength in direct and reversed rotating bending, torsion and biaxial loading conditions. Effects of stress concentrators and surface treatments on fatigue. Design for corrosion control. Types of wear and design for wear control.

2. **Threaded Fasteners, Power Screws, Rivets, Welding and Bonding**: Terminology, materials and design methodologies for threaded fasteners and power screws. Design of rivet and welded assemblies. Stress, strain and displacement evaluation for fasteners, power screws, rivet, welded and bonded assemblies under static and dynamic loading conditions.

3. **Design of Clutches, Brakes, Belts, and Chains**: Disk and tapered clutches and brakes. Energy absorption and cooling. Long shoe drum and band brakes. Flat, V-shaped and toothed belts. Roller and inverted-tooth chains. Hydrodynamic drives and fluid couplings.

4. **Elastic Elements**: Torsion bar, coil and beam spring design. Coil spring stress and deflection equations. Stress and strength analysis for helical compression springs. End designs of helical compression springs. Buckling of coil springs in compression. Energy storage in elastic elements.

5. **Shafts and Bearings**: Provision for shaft bearings. Rotating shaft dynamics and shaft design techniques. Keys, pins, splines and couplings. Hydrodynamic lubrication in sliding bearings and Petroff's equation for bearing friction. Thrust bearings and elasto-hydrodynamic lubrication. Rolling bearing types, mounting, design and catalogue selection.

6. **Gear Design, Analysis and Selection**: Spur gear nomenclature and geometry. Interference, contact ratio, gear-tooth bending stresses and Lewis equation. Surface fatigue analysis in gear-tooth. Spur gear design procedures and materials. Bevel, helical and worm gears: nomenclature and geometry, thermal capacity. Gear trains.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Evaluate stresses, strains and displacements on components under combined static and dynamic loading conditions. Evaluate fatigue strength of components under various dynamic loading conditions and surface finish and treatments. Select materials and apply design methodologies for corrosion and wear control.
2. Design and analyze assemblies with fasteners, rivets, weldings and bondings. Analyze and evaluate power screw assemblies used in mechanical engineering applications from the point of view of lift capability and precision.
3. Develop, design and analyze mechanical engineering systems employing clutches, brakes, belts, and chains.
4. Analyze elastic elements from the points of view of displacements and stresses for various materials and geometries. Design assemblies employing elastic elements in tension, compression or torsion. Design compressive helical coil springs with buckling control.
5. Analyze dynamics of rotating shafts and design optimized shafts under combined static and dynamic loads. Evaluate lubrication regimes in sliding hydrodynamic bearing and evaluate moments of friction using Petroff's equation. Know the analytic limits of evaluating hydrodynamic bearings using the partial differential equations Navier - Stokes. Select rolling bearings for various loading conditions and design systems employing such bearings.
6. Evaluate interference, contact ratio, gear-tooth fatigue and bending stresses for various gear types. Design gear assemblies for various dynamic loadings and evaluate their

thermal capacity. Employ gear trains at optimal torque ratios in mechanical engineering systems.

7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with 13 weeks of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Textbook

- Juvinall, R., Marshek, K. – *Fundamentals of Machine Component Design*, 5th Edition, John Willey and Sons, Hoboken, New Jersey, United States, 2012

References

- Marghitu, D. – *Mechanical Engineer's Handbook*, Academic Press, San Francisco, United States, 2001

Readings and Resources

- Budynas Nisbett – *Shigley's Mechanical Engineering Design*, McGraw Hill, New York, United States, 2005

YouTube Clips

1. https://www.youtube.com/watch?v=CBVlYibdF3M&list=PLKz_xsS_duovIcKifF1vL_qE8xDoocWf5
2. https://www.youtube.com/watch?v=mzWMdZZaHwI&list=PL3D4EECEFAA99D9BE
3. https://www.youtube.com/watch?v=nqhyCzrFp1s

Relevant Unitech Policies

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http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies.

Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Heat Transfer
Subject Code	ME313
Duration	13 teaching weeks, 1 examination week, 1 mid-semester week
Contact Hours	6 hours per week (4 Lec / 1 Tut / 1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME211 Basic Thermodynamics and Cycles ME223 Fluid Mechanics
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

The subject enables students to acquire basic understanding of fundamental of heat flow. Students will apply their knowledge in solving problems involving conduction, convection and radiation heat transfers. Students will be able to apply their knowledge to understand heat transfer systems in practical industries and will be equipped to analyse/design heat transfer systems/surfaces and heat exchangers.

Subject Topics

1. Introduction
2. One dimensional steady state conduction
3. Forced convection
4. Free convection
5. Radiation
6. Heat exchangers

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe the mechanisms of heat transfer between elements of a system
2. Determine the correct assumptions and approximations for tackling practical situations
3. Analyse one-dimension conduction problems
4. Solve problems involving one or more modes of heat transfer
5. Apply knowledge and useful information gained on design and analysis of heat transfer systems.
6. Working in teams to undertake laboratory exercises, analysing and discussing the

outcomes and communicate those via professional reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination: The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

John H Lienhard IV and John H Lienhard V., A heat transfer text book, Fourth Ed., Phlogiston Press, Cambridge Massachusetts, MIT 2018.

References

Moran M.J., Shapiro H.N., Boettner D.D. and M.Bailey, Fundamentals of Engineering Thermodynamics, 7th Ed., John Wiley * Sons, 2011.

Eastop, T.D. & McConkey, A., Applied Thermodynamics for Engineering Technologists, 5th Ed., Prentice Hall, 1993.

Readings

Rogers, G.F.C, & Mayhew, Y.R., Thermodynamic and Transport Properties, 5th Ed., (Basil Blackwell, 1995)

YouTube Clips

The following YouTube Clips should help augment your weekly lectures

1. https://www.youtube.com/watch?v=GRY6MpN2QW8
2. https://www.youtube.com/watch?v=kNZi12OV9Xc
3. https://www.youtube.com/watch?v=tDs4cFOqTdM

Relevant Unitech Policies

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http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Manufacturing Process and Design
Subject Code	ME314
Duration	13 Teaching Weeks,1 ExaminationWeek,1Mid-Sem Week
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN113 Engineering Materials and Properties
Co requisites	Nil
Subject Coordinator	TBA

Synopsis

Basic Manufacturing Process and Design enables students to attain basic knowledge of manufacturing and measuring of various machine parts and components. The subject covers the various types of manufacturing processes like casting, forming and joining required for the conversion of raw materials into products. Students will review the relative advantages of various manufacturing processes and the basis of choosing a manufacturing method. The subject introduces the various equipment and tools used in different manufacturing methods.

Subject Topics

1. Introduction to Manufacturing
2. Casting Techniques and Design of Moulds
3. Forming Process and Press Tool Design
4. Joining Process
5. Powder Metallurgy
6. Processing of Plastics and Composite Materials

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to

1. Differentiate between various manufacturing processes and propose suitable manufacturing methods considering manufacturing requirements, raw materials and economics of manufacturing.
2. Identify various casting defects and propose potential remedial methods through design of gating systems.
3. Compare various forming process and design forging dies and press tools.

4. Critically appraise and apply various joining techniques like welding, soldering and brazing to obtain desired joints
5. Apply powder metallurgy and plastics processing techniques to produce alloys and composite materials.
6. Working in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

S. Kalpakjian and S.R. Schmid, Manufacturing Engineering and Technology, 6th Ed., Pearson Education (Singapore) Pvt. Ltd., 2010.

References

P.N.Rao, Manufacturing Technology Volume I, 3rd Ed., McGraw Hill Education (India) Private limited, 2013

Readings

A. Ghosh and A. K. Mallik, Manufacturing Science, 2nd Ed., East-West Press, 2010

YouTube Clips

The following YouTube Clips should help augment your weekly lectures.

Sand casting fundamentals at:

https://www.youtube.com/watch?v=pwaXCko_Tkw

Forging Process Fundamentals at:

https://www.youtube.com/watch?v=dFnN1YtomNc

Forming Process Fundamentals at:

https://www.youtube.com/watch?v=GfZL4cn-GGE

Welding Process fundamentals at:

https://www.youtube.com/watch?v=OWThL97tq3k

Relevant Unitech Policies

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http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Project Management and Economics
Subject Code	EN321
Duration	13 Teaching Weeks, 1 Examination Week and 1 Mid Sem Week.
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	Nil
Co-requisites	Nil
Academic Staff	TBA

Synopsis

This course provides students with skills and knowledge in organizing multi-disciplinary teams to achieve successful project outcomes; enables students to understand the key components of a successful project and to embed the necessary processes, components, and attributes into execution of their projects. It will help the students to gain the knowledge required for project evaluation and selection, initiation and planning, project execution, monitoring and controlling the project. Students will also acquire knowledge to develop a project plan, schedule, budget, and assess project risks.

Subject Topics

1. Introduction to Engineering Project Management
2. Project Planning
3. Evaluation of Alternative Projects Using Engineering Economics tools
4. Pricing and Estimation of project cost.
5. Network Scheduling Techniques
6. Risk Management

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to

1. Demonstrate a thorough understanding of the basics of project management.
2. Become an effective member of a project team and manage projects by completing a group project.
3. Apply engineering economics tools in evaluation of projects and selection of best alternative.
4. Analyze and refine project time and cost estimates to define project baseline, schedule and budget.
5. Recognize and respond to risk events and issues.

6. Work collaboratively in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Subject Text

1. H. Kerzner Project Management A System Approach to Planning, Scheduling and Control, 10th Ed., John Wiley * Sons, 2009.
2. L. Blank & A. Tarquin, Basics of Engineering Economy, 2nd Ed, McGraw-Hill Education, 2013

References

1. G. R. Heerkens, Project Management, McGraw-Hill, 2002
2. R. Panneerselvam, Engineering Economics, PHI Learning Pvt. Ltd., 2013

YouTube Clips

The following YouTube Clips should help augment your weekly lectures.

Project Management Fundamentals at:

https://www.youtube.com/watch?v=rBSCvPYGnTc

https://www.youtube.com/watch?v=6LJLIfRfrts

Fundamentals of Project Planning at:

https://www.youtube.com/watch?v=y_I6MBuTTQk

Network Analysis at:

https://www.youtube.com/watch?v=-TDh-5n90vk

Critical Path Method at:

https://www.youtube.com/watch?v=URdxhl_8qIE

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Vibration Analysis
Subject Code	ME321
Duration	13 Lecturing Weeks, 1 Examination Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week (4 Lec./1 Tut./1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN212 – Engineering Mathematics III
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces students to the fundamental field of mechanical vibrations analysis. All mechanical and structural engineering systems can be modeled as mass-spring-damper systems and the students are required to identify such components and study their interactions, effects and methods of control. The included topics address the analysis of free, damped and forced vibrations, the modeling of periodic motions as harmonic functions, the analysis of single and multiple degrees of freedom vibrating and the evaluation of natural frequencies and mode shapes. Also included are topics on vibration control, measurement and related applications.

Subject Topics

1. **Fundamentals of Mechanical Vibrations**: Vibrations classification. Procedures in vibrations analysis. Vibrations terminology. Spring, mass and damping elements. Harmonic motion and harmonic analysis. Numerical approaches using Matlab.
2. **Free Vibrations of Single Degree of Freedom. Harmonically Excited Vibrations**: Free vibrations of single degree of freedom systems without and with damping. System responses. Rayleigh's energy method. Coulomb and hysteretic damping. Equations of motion of harmonically excited vibrations and system responses. Stability analysis.
3. **Vibrations under General Forcing Conditions**: Forced vibrations under general conditions. Response spectrum, Laplace transforms. Equation of motion for forced vibrations. Self-excitation and stability.
4. **Multiple Degrees of Freedom Vibrations**: Modeling of multiple degrees of freedom vibrations. Newton and Lagrange methods.

5. **Determination of Natural Frequencies and Mode Shapes**: Fundamental frequency of composite systems using Dunkerley's formula. Rayleigh, Holzer and Jacobi's methods in evaluating natural frequencies and modal vectors.

6. **Mechanical Vibrations Control and Measurement**: Control of vibrations at the source. Balancing of shafts and reciprocating engines. Control of natural frequencies. Damping, vibration absorbers and isolators. Transducers for vibration measurement. Frequency measuring instrumentation. Vibration exciters. Dynamic testing of machines and structures.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Apply the terminology, classification and methodology involved in vibrations analysis. Evaluate equivalent masses, springs and dampers in vibrating systems. Perform harmonic analysis and approximate periodic functions with harmonic functions using Fourier series.
2. Evaluate vibrating systems of a single degree of freedom with and without damping. Analyze the responses and stability of systems under harmonically excited vibrations.
3. Analyze forced vibrations under general conditions. Establish the governing equation of motion for forced vibrations, evaluate its solutions and discuss the stability of under-damped, critically damped and over-damped vibrating systems.
4. Design, model and evaluate multiple degrees of freedom vibrating systems using Newton and Lagrange methods.
5. Determine natural frequencies and vibration modes of composite systems using Dunkerley's formula. Evaluate natural frequencies and modal vectors on vibrating systems using Rayleigh, Holzer and Jacobi's methods.
6. Evaluate methods of controlling vibrations at the source. Analyze natural frequencies and vibration modes of systems in order to avoid resonance. Analyze and calibrate damping ratios. Design systems with vibration absorbers and isolators. Evaluate methods of dynamic testing of machines and structures.
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with 13 weeks of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Textbook

- Rao, S. – *Mechanical Vibrations*, 5th Edition, Prentice Hall, New York, 2011

References

- Gans, R.- Mechanical Systems - *A Unified Approach to Vibrations and Controls*, Springer, 2015

Readings and Resources

- Thomson, W., Dahleh, M. - *Theory of Vibrations with Applications*, 5th Edition, Prentice Hall, 1998

YouTube Clips

1. https://www.youtube.com/watch?v=S2-26LR8_Es&list=PL2ym2L69yzkZJ1fY3SQ1JCyvZIoJYXQGZ
2. https://www.youtube.com/watch?v=7gQCUhA3PtE&list=PLWqFWuIMqmHTBPgqwabliwB4EOR02nMr-
3. https://www.youtube.com/watch?v=9r630K5HmJc&list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR

Relevant Unitech Policies

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website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Metal Cutting and Machine Tools
Subject Code	ME322
Duration	13 Teaching Weeks, 1 Examination Week and 1 Mid Sem Week.
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME314- Manufacturing Processes and Design
Co requisites	Nil
Academic Staff	TBA

Synopsis

Metal Cutting and Machine Tools enables students to demonstrate tool geometry and define tool angles in different systems. Students will be able to differentiate between Oblique and Orthogonal cutting and illustrate the mechanism of chip formation in machining ductile and brittle materials. They will gain knowledge on constructional details and application of various types of machine tools along with their relative advantages and disadvantages. They will be introduced to various gear manufacturing and surface finishing process. They will be able to explain various non-traditional machining process and their applications. They will be aware of fundamentals of CNC part programming. Various principles for designing of cutting tools and Jigs and fixtures will be introduced to the students.

Subject Topics

1. Theory of Metal Cutting
2. Geometry and Design of Single Point Cutting Tools
3. Features and Specifications of Machine Tools, Jigs and Fixtures
4. Manufacturing of Gears
5. Non-traditional Machining Practices
6. CNC Machine Tools in Advanced Machining Practices

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to

1. Design cutting tools and assess their lives.
2. Differentiate between Oblique and Orthogonal cutting and illustrate the mechanism of chip formation in machining ductile and brittle materials.
3. Estimate machining times required for various products.

4. Manufacture gears.
5. Demonstrate an understanding of non-traditional machine tools and their application in machining and surface finishing process.
6. Write part programming codes to cut simple geometries in CNC Machine tools.
7. Working in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

S. Kalpakjian and S.R. Schmid, Manufacturing Engineering and Technology, 6th Ed., Pearson Education (Singapore) Pvt. Ltd., 2010.

References

P.N.Rao, Manufacturing Technology Volume II, 3rd Ed., McGraw Hill Education (India) Private limited, 2013

Readings

A B Chattopadhayay, Machining and Machine Tools, 3rd Ed., Wiley, 2011.

YouTube Clips

The following YouTube Clips should help augment your weekly lectures.

Single point cutting tool geometry at:

https://www.youtube.com/watch?v=bUrp8JMRwx4

https://www.youtube.com/watch?v=jskReAnzjaQ

Mechanics of Metal Cutting at:

https://www.youtube.com/watch?v=dVGrNfZBsf0&t=31s

Non Traditional Machining Process at:

https://www.youtube.com/watch?v=Vw-cUiBLuHw
https://www.youtube.com/watch?v=qVcwT0FfAIc
https://www.youtube.com/watch?v=PaYInS9axxw

Relevant Unitech Policies

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http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Introduction to Finite Element Method
Subject Code	ME323
Duration	13 teaching weeks, plus 1 examination week and 1 mid-semester week
Contact Hours	6 hours per week (3 Lect; 2 Tut; 1 Proj)
Credit Points	18
Delivery Mode	On campus
Prerequisites	EN112, EN121, EN212 and ME212
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

Introduction to Finite Elements enables students to develop their understanding of finite element method through integral formulations and variational methods, second-order differential equations in one dimension, eigenvalue and time-dependent problems, single-variable problems in two dimensions, interpolation functions, numerical integration and modelling considerations.

Subject Topics

1. Introduction
2. Integral formulations and variational methods
3. Second-order differential equations in one dimension
4. Eigenvalue and time-dependent problems
5. Single-variable problems in two dimensions
6. Interpolation functions, numerical integration and modelling considerations

Subject Learning Outcomes

On completion of this subject, students should be able to:

1. Describe the basic terminologies and definitions used in the development of concepts, theorems and techniques
2. Outline the main concepts, theorems, and techniques
3. Apply the concepts, theorems and techniques to solve problems
4. Analyze, synthesize, evaluate and design FEM problems
5. Work together with effective communication, professionalism and ethical responsibility

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1 - Assignment: The assignments are intended to support students achieving the learning outcomes for the subject and will contribute 20% towards the final grade for the subject.

Assessment 2 – Class Test: The Test contributes 30% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 3 – Final Exam: The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject.

Assessment 4 – Lab/Project Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 10% towards the final grade for the subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Textbook

J. N. Reddy, An *Introduction to the Finite Element Method*, 3rd Ed., McGraw-Hill Education, New York, 2006.

References

Daryl L. Logan. N. Reddy, A First Course in the Finite Element Method, 6th Ed., Cengage Learning Engineering, Boston, 2017.

Readings

Recommended Books and Reference Material

Richard L. Burden and J. Douglas Faires, Numerical analysis, 9th Ed., Brooks/Cole Cengage Learning, Boston, 2010

YouTube Clips

The following youtube clips should help augment your weekly lectures.

Integral formulations and variational methods at:

https://www.youtube.com/watch?v=8VFql064HAE

Finite element method for second-order differential equations at:

https://www.youtube.com/watch?v=9WE4zKCLxW8

Finite element method for single-variable problems in two dimensions at:

https://www.youtube.com/watch?v=7L3lUy1wtSk

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Non-Destructive Testing
Subject Code	ME324
Duration	13 Teaching Weeks, 1 Examination Week, 1

Mid Semester Week

Contact Hours 6 Hours/Week (4 Lect./ 1 Tut./1 Proj.)

Credit Points 20

Delivery Mode On campus

Prerequisites EN113 – Material Engineering and Properties

Corequisites Nil

Synopsis

The subject introduces the students to study the Fundamental of Non-Destructive Testing Techniques. The knowledge of this subject is essential for mechanical engineers to examine structural components that are in service for defects and flaws that could lead to premature failure.

Subject Topics

1. **Introduction:** Destructive testing methods, and some practical examples. Visual Testing: Tools include fiberscopes, portable video inspection, robotic crawlers, magnifying glasses and mirrors.
2. **Dye Penetrant Inspection:** Procedure, **m**aterials type, geometry, defect type and location, advantages and disadvantages, and applications.
3. **Magnetic Particle Inspection:** Procedure, materials type, geometry, defect type and location, advantages and disadvantages, and applications.
4. **Ultrasonic Inspection:** Procedure, materials type, geometry, flaws type and location, advantages and disadvantages, and applications.
5. **Eddy Current Inspection:** Procedure, materials type, geometry, flaws position and location, advantages and disadvantages, and applications.
6. **Radiography Inspection:** Procedure, materials type, geometry, defect type and location, advantages and disadvantages, and applications.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. To provide the fundamental knowledge of non-destructive testing methods.
2. To encourage students practice communication skills and teamwork effort.
3. Identify materials flaws using visual inspection and automated machine.

4. Acquire knowledge on general procedures, techniques, and precautions in failure geometry design components.
5. Ability to undertake materials defects problem identification, formulation and solutions.
6. To be able to formulate and write technical report and technical presentation.
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15-week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

- Annual Book of ASTM Standards. Metals Test Methods and Analytical Procedures: Nondestructive Testing. American Society for Testing and Materials, Columbus, OH.

References

- Grandt, A. F. Jr., Fundamentals of Structural Integrity: Damage Tolerant Design and Nondestructive Evaluation, John Wiley & Sons, Inc. Hoboken, NJ, 2004.
- Annual Book of ASTM Standards. Metals Test Methods and Analytical Procedures: Nondestructive Testing. American Society for Testing and Materials, Columbus, OH.

- Introduction to Non-destructive. John Wiley & Sons. 2013

Readings and Resources

- Fundamental of Non-destructive Testing Lecture Notes.

YouTube Clips

The following YouTube Clips should help augment your weekly lectures.

1. https://www.youtube.com/watch?v=WoHiE5eGaD4
2. https://www.youtube.com/watch?v=KqHk0I12wGk
3. https://www.youtube.com/watch?v=xEK-c1pkTUI

Relevant Unitech Policies

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http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Research Project A
Subject Code	EN411
Duration	13 teaching weeks, plus 1 examination week and 1 mid-semester week
Contact Hours	6 hours per week (1 hour lecture, 5 hours project directed, 5 hours self-study)
Credit Points	20
Delivery Mode	On campus
Prerequisites	All Year 3 Subjects
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

This subject outlines the commencement of undertaking of research that will augment professional work in the student's engineering discipline and form a foundation for future learning and professional development. It is intended to help students develop the cognitive skills for to think critically about research methods and literature reviews. The subject covers the introduction to research investigation through the creation of a research hypothesis, critical review and interpretation of literature on an approved topic and communication of those outcomes. The research provides an opportunity for the practical application and integration of the student's professional background and skills, and previous studies in the discipline's supporting subjects. The subject is student focused with students progressing at their own pace to meet assessment tasks, supported by their academic supervisor.

Subject Topics

Topic 1 concerns developing a research proposal and outlines the various types of research that may be undertaken by engineers and suggests that most engineers typically undertake research in the applied research space, using a quantitative approach.

Topic 2 stresses the importance of developing the research hypothesis/question for the topic is stressed along with the need to ensure that the proposed research can be completed within the time allocated to the project.

Topic 3 outlines definitions, structures and the role of the literature review in a research report. It stresses how one of the most important roles of the literature review is to show where the proposed research fits within, and augments, the existing international contemporary literature.

Topic 4 involves the provision of guidance on structuring and writing the Literature Review Report and communication the outcomes via an audio visual presentation.

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Explain the various types of research that may be undertaken by engineers and the use of quantitative and qualitative research methodologies.
2. Develop and justify a research question/hypothesis and proposal supported by an appropriate quantity and quality of references.
3. Source and critically evaluate and synthesize research literature to determine the level of contemporary knowledge in a specialist area.
4. Construct a literature survey that places a research hypothesis/question within the national and international contemporary space and justifies the research hypothesis.
5. Create audio visual presentations that communicates the outcomes of the research, including the literature survey to a diverse audience.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the *Research Project A Final Report.*

Students must also refer to the individual Subject Assessment Details.

Assessment Task 1 requires the development of the ***Research Proposal***, the research proposal/question and outlining the proposed research background and methodology to ensure that the proposed research is achievable. The approved proposal will be presented to the student cohort, academic staff and the wider profession. It is worth 10% of the total marks for the Subject.

Assessment Task 2 helps to facilitate the structured development of the research project and its literature review by requiring two ***Research Project A Progress Reports,*** which must include mapping against the semester's plan and a summary of the international literature reviewed to date and other outcomes. The progress reports will be presented to the student cohort, academic staff and the wider profession. They are worth 10% each and 20% overall of the total marks for the Subject.

Assessment Task 3 requires the production of the ***Research Project A Final Report*** that will largely be a critical review of the international literature and include ethical and sustainability aspects. Details of any other research outcomes will be included. The final report will be presented in a form that will integrate well into the Research Project Thesis that is the culmination of Research Project. It is worth 50% of the total marks for the Subject.

Assessment Task 4 provides an opportunity for the ***Audio-visual Presentation of the Research Literature Review Outcomes***. The presentation must reflect and summarise the ***Research Project A Final Report***. It will be at a professional level and include both visual and audio and must be delivered to the student cohort for the Subject, academic staff and the wider profession. It is worth 20% of the total marks for the Unit.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework. The subject is student focused and the amount of time spent by student will vary significantly.

Subject Text

Theil, D.V 2014, *Research Methods for Engineers*, Cambridge University Press, Cambridge

References and Readings

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link: http://www.unitech.ac.pg/unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Operations Management
Subject Code	ME411
Duration	13 Teaching Weeks, 1 Examination Week, 1 Mid Sem Week
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN212-Engineering Mathematics III
Co requisites	Nil
Academic Staff	TBA

Synopsis

Operation Management enables students to fully appreciate the role and contribution of Operations Management in achieving organizational competitiveness. Student will gain knowledge about various phases and attributes essential for designing of product. The students will be able to forecast demand for organisations and plan resources required to fulfil these demands under different circumstances. The subject covers the various methodologies employed for facility layout and work place design. Students will study the various aspects of human resources in operations management like Job design and ergonomics. The concepts of supply chain management will be introduced.

Subject Topics

1. Scope of Operations Management
2. Product Design
3. Demand Forecasting
4. Facilities Planning and Analysis (Facility selection, Facility Layout, workplace design)
5. Planning and Coordination (Aggregate Planning, MRP and ERP, Scheduling)
6. Inventory Management
7. Human Resources in Operations Management (Job Design, Ergonomics)
8. Basics of Supply Chain Management

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to;

1. Analyse the role and contribution of Operations Management in achieving organizational competitiveness.

2. Estimate the demand for any item for any organisation under varying circumstances.
3. Apply systematic approaches in the design and implementation of operating systems
4. Develop suitable inventory management policies for organisations operating in different sectors.
5. Design appropriate work systems and distribution networks for any organisation.
6. Work collaboratively in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignmentsare intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 14 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

R.S. Russell and B. W. Taylor, Operations Management Creating Value along the Supply Chain, 9th Ed., John Wiley & sons, 2016.

References

R. D. Reid and N. R. Sanders, Operations Management: An Integrated Approach, 6th Ed., Wiley, 2015.

Readings

R. J. Tersine, "Production/Operations Management", 2nd Ed, North-Holland, 1985

YouTube Clips

The following YouTube Clips should help augment your weekly lectures.

Facility Layout Planning at:

https://www.youtube.com/watch?v=-aGk5-yx340

https://www.youtube.com/watch?v=udF-0FivGfk

Layout Designing at:

https://www.youtube.com/watch?v=TG7kzh2Uz08

Inventory Management Fundamentals at:

https://www.youtube.com/watch?v=2n9NLZTIlz8

Inventory Management at Amazon case at:

https://www.youtube.com/watch?v=dAXdeqcHBp4

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Control Engineering
Subject Code	ME412
Duration	13 Teaching Weeks, 1 Examination Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week (4 Lec./1 Tut./1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN212 – Engineering Mathematics III
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces students to the field of automatic control, of major importance in robotics and space exploration. The included topics address theoretical and practical aspects in control engineering, like modeling and optimization of dynamic systems in Laplace mathematics, sensors and actuators, control strategies, or transient and steady-state response analysis. Of significant importance are topics related to the experimental implementation and optimization of dynamic processes.

Subject Topics

1. **Introduction, Definitions and Examples**: Mathematical challenges in control engineering. Control variable, plant, disturbance and process definitions. Speed and temperature-controlled systems. Closed loop and feedback in automatic control. Experimental capabilities in process control.

2. **Laplace Mathematics in Control Engineering**: Operational methods for linear differential equations. Complex functions, Euler's theorem, direct and inverse Laplace transforms and related theorems. Partial fraction expansion, zeros and poles in automatic control. Direct and inverse Laplace transforms for common functions.

3. **Matlab Implementation in Control Engineering**: Analytical methods for partial-fraction expansion and numerical implementations in Matlab. Numerical applications involving distinct and multiple poles. Numerical solutions for linear time-invariant differential equations.

4. **System Dynamics and Modeling in Process Control**: Control parameters. Mass and energy balance differential equations. Feedback, feedforward, cascade, interactive and ratio controls. Transfer and weighting system functions.

5. **Block Diagrams, Control Actions and Engineering Applications**: Closed loop and open loop block diagrams and transfer functions. Simple and combined control actions.

Proportional-Integral-Derivative controls. Block diagram reduction. Automatic control implementation in electrical, electronic and thermo-fluidic systems.

6. **Sensors and Actuators. Transient and Steady-State System Responses. Root Locus Analysis**: Servosystems and sensors employed in control engineering. Test signals and signal analog to digital and digital to analog conversion, filtering and amplification. Transient and steady-state system responses. System stability and steady-state errors. First, second order and higher order systems. Matlab implementation for second and higher order systems. Routh's stability criterion. Root locus analysis.

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Define the characteristics of dynamic systems and evaluate experimental capabilities in control engineering.
2. Analytically evaluate governing differential equations encountered in control engineering by direct and inverse Laplace transforms. Perform partial fraction expansions, establish the position of poles and zeros in complex space and explain their significance in control engineering.
3. Employ Matlab for numerical evaluation of solutions for linear time-invariant differential equations encountered in automatic control.
4. Design and model system dynamics using mass and energy balance differential equations. Establish transfer and weighting functions for various systems involved in control engineering.
5. Built and reduce block diagrams for common systems encountered in automatic control. Evaluate typical automatic control systems encountered in electric, electronic and thermo-fluidics applications.
6. Evaluate sensors and actuators and implement them into automatic systems. Analyze transient and steady-state system responses and evaluate their stability.
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with 13 weeks of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Textbook

- Ogata, K. – *Modern Control Engineering*, 4th Edition, Prentice Hall, New Jersey, 2002

References

- Bishop, R. – *Modern Control Systems Analysis and Design Using Matlab and Simulink*, Addison Wesley Publishing, New York, United States, 2004

Readings and Resources

- TecQuipment – CE 117 Process Trainer, Nottingham, United Kingdom, 2008
- TecQuipment – CE 2000 Software, Nottingham, United Kingdom, 2008

YouTube Clips

- https://www.youtube.com/watch?v=7LZSjgZz-Qw&list=PLxn52v8fxX5l5tGzU1NAxRDkgqxK0k5UZ
- https://www.youtube.com/watch?v=g53tqrBjIgc&list=PL5105727DD6E8DE98
- https://www.youtube.com/watch?v=vVFDm__CdQw&list=PLA74601484F6994D8

Relevant Unitech Policies

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  website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Automotive Engineering
Subject Code	ME413
Duration	13 teaching weeks, 1 exam week and 1 mid semester week
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN122 Engineering Mechanics, ME223 Fluid Mechanics
Co-requisites	Nil
Academic Staff	TBA

Synopsis

The Automotive Engineering course exposes students to the component parts, accessories, systems and technologies of the automotive vehicle. They learn the principles underpinning the operation of vehicle systems and subsystems. They also develop the knowledge and skills in recent trends in automotive industry with regards to hybrid and autonomous cars. Laboratory activities provide them with opportunities to learn about the range of components and materials used in the manufacture of automotive vehicles.

Subject Topics

1. Introduction to Automotive Engineering
2. Transmission System
3. Tires.
4. Suspension System
5. Braking System Design
6. Steering System
7. Hybrid Cars
8. Autonomous Cars

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Describe what an automobile is as well as its classification according to the type.
2. Analyse the various systems and subsystem that make an automobile.
3. Apply the knowledge of automobile types, system and subsystem to deal with engineering challenges in automobiles.
4. Design automobiles meeting the current trend in automotive industry such as hybrids and autonomous cars
5. Apply their knowledge and skills in automobile repair and maintenance;

6. Working in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Unit Assessment consists of Test, Assignment, Laboratory/Project Concept and a Final Written Examination.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

The required text for the subject 1.is:

R. Sakthivel, Faisal O. Mahroogi, S. Narayan, S. Abubakar, M. U. Kaisan and Youssef Alammari; Introduction to Automotive Engineering, Wiley Global Headquarters, 111 River Street, Hoboken, NJ 07030, USA, ISBN 978-1-119-47980-2

References

Essential Reference

Dr.G.K. Vijayaraghavan and Dr. S. Sundaravalli., Automobile Engineering, 2013, Lakshmi Publications, Chennai, ISBN-13:9788192030104.

David A. Crolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, 2009, Butterworth-Heinemann, Linacre House, Jordan Hill, Oxford OX2 8DP, UK, First edition 2009ISBN: 978-1-85617-577-7

Readings

Recommended Books and Reference Material

https://www.technicalbookspdf.com/automobile-engineering/

http://www.faadooengineers.com/threads/47759-a-textbook-of-automobile-engineering-by-rk-rajput-free-download-pdf

Youtube Clips

1. https://www.youtube.com/watch?v=LZ82iANWBL0&list=PLbMVogVj5nJTW50jj9_gvJmdwFWHaqR5J
2. https://www.youtube.com/watch?v=zy_zipMEH7g&list=PL0ZXVmmropDQrPdWqVhuy9Y-ziqt4Axkr
3. https://www.youtube.com/watch?v=0LBdCeht3TQ

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Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Flexible Manufacturing System
Subject Code	ME414
Duration	13 Teaching Weeks, plus 1 Examination Week and 1 Mid Semester Week.
Contact Hours	6 hours per week (4 Lec/1 Tut/1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME322 Metal Cutting and Tools
Co-requisites	Nil
Academic Staff	TBA

Synopsis

This course is designed to provide a comprehensive technical knowledge about production automation and the role of the computer in modern manufacturing systems. Students will be acquainted with cellular design and Lean manufacturing systems and cells. This course also will introduce the students about application of various automated material handling system and robots in manufacturing. Finally, the hardware requirements and NC part programming will be introduced to the students.

Subject Topics

1. Evolution of Manufacturing Systems
2. Manual Assembly Lines and Automated Production Lines
3. Cellular Design and Lean Systems and Cells in Manufacturing
4. Flexible Manufacturing System Support Equipment
5. FMS Computer Hardware, Software, and Communication

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to

1. Distinguish between different automation strategies and economically evaluate conventional and automated manufacturing system
2. Analyze automated production flow lines and design automated assembly systems.
3. Apply group technology concepts for the analysis and design of flexible manufacturing systems FMS.
4. Analyze and design automated materials handling systems.
5. Determine the requirement for numerically controlled production system and design and implement NC part programming.

6. Working in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignmentsare intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

M.P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, 4th Ed., Prentice Hall, 2008

References

A. Raouf M. Ben-Daya, Flexible Manufacturing Systems: Recent Developments, Volume 23, 1st Edition, Elsevier Science, 1995

Readings

I.Gibson, D. Rosen, B. Stucker, Additive Manufacturing Technologies, Springer, 2015

N. Singh, Systems Approach to Computer-Integrated Design and Manufacturing, Wiley, 1995

YouTube Clips

The following YouTube Clips should help augment your weekly lectures

Flexible Manufacturing system fundamentals at:

https://www.youtube.com/watch?v=peKvC7GdYNg

FMS System Components at:

https://www.youtube.com/watch?v=YGtg4OPSFhc

Audi Smart Factory Case at:

https://www.youtube.com/watch?v=sqCbYd8O8MU

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Course(s)	Common to all Bachelor of Engineering (NQF Level 8)
Subject Name	Research Project B
Subject Code	EN421
Duration	13 teaching weeks, plus 1 examination week and 1 mid-semester week
Contact Hours	6 hours per week (1 hour lecture, 5 hours project directed, 5 hours self-study)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN411 Research Project A
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

This subject continues the undertaking of research that was commenced in Research Project A. It is intended to continue to augment the professional work in the students engineering discipline to form a foundation for future learning and professional development and assist to develop cognitive skills. The subject covers research methods, literature reviews, plans, analysis and presentation. The subject provides an introduction to planning a research investigation, developing testing regimes, and data analysis, interpretation and presentation. The final outcomes of the subject will be creation of a Research Project Thesis and an accompanying audio visual presentation. The subject is student focused with students progressing at their own pace to meet assessment tasks, supported by their academic supervisor.

Subject Topics

Topic 1 provides an overarching framework to planning a research program, outlining the need to develop a schedule for the entire project and to identify the breadth and depth of testing required to generate adequate and reliable data.

Topic 2 outlines the importance of accurate analysis, interpretation and presentation of experimental results and explores the use of regression and correlation as tools to help explain trends in data. The role of hypothesis testing in engineering is introduced.

Topic 3 involves the provision of guidance on structuring and writing the Research Project Thesis and preparing the accompanying audio visual presentation.

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Develop and justify an integrated research plan and select and apply appropriate research methodologies
2. Source and critically evaluate and synthesise research literature to determine the level of contemporary knowledge in a specialist area.
3. Undertake experimentation, data collection through laboratory and/or field studies and/or critical analysis of the literature.
4. Judge the degree to which research outcomes are supported by the research data and form appropriate conclusions and recommendations based on the research.
5. Apply established theories and techniques to present the significance of their research findings and make informed recommendations for future research directions.
6. Create a research report and audio visual presentation that communicates the outcomes of the research to a diverse audience.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the Research Project Thesis.

Students must also refer to the Subject Assessment Details.

Assessment Task 1 requires the development of the ***Research Plan***, outlining the proposed research schedule to ensure that the proposed research is achievable. It is worth 10% of the total marks for the Subject. The approved research plan will be presented to the student cohort, academic staff and the wider profession.

Assessment Task 2 helps to facilitate the structured development of the research project and its outcomes by requiring two ***Research Project B Progress Reports,*** which must include mapping against the ***Research Plan*** and a summary of all research outcomes to date. The progress reports will be presented to the student cohort, academic staff and the wider profession. They are worth 10% each and 20% overall of the total marks for the Subject.

Assessment Task 3 requires the production of the ***Research Project Thesis***. The thesis is the capstone of the degree and be around 6000 words excluding tables, graphs and appendices. It will include ethical and sustainability aspects. It is noted that some theses may vary significantly in length due to the research topic. It is worth 60% of the total marks for the Subject.

Assessment Task 4 provides an opportunity for the ***Audio-visual Presentation of the Research Outcomes***. The professional presentation must reflect and summarise ***Research Project Thesis*** and include both visual and audio and must be delivered to the student cohort for the Subject. It is worth 10% of the total marks for the Subject.

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework. The subject is student focused and the amount of time spent by student will vary significantly.

Subject Text

Theil, D.V 2014 Research Methods for Engineers, Cambridge University Press, Cambridge

References and Readings

Numerous links are provided within the Subject Topics to research organisations, international universities, YouTube clips, and research databases.

Relevant Unitech Policies

It is important that all students familiarise themselves with the University of Technology Assessment Guidelines including those on plagiarism and other relevant policies via the link: http://www.unitech.ac.pg/unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Introduction to Mechatronics
Subject Code	ME421
Duration	13 Lecturing Weeks, 1 Examination Week, 1 Mid-Semester Week
Contact Hours	6 Hours/Week (4 Lec. /1 Tut. /1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	EN212 – Engineering Mathematics III
Corequisites	Nil
Subject Coordinator	TBA

Synopsis

The subject introduces students to the interdisciplinary field of mechatronics. The included topics address theoretical and practical aspects encountered in the design, selection, analysis, and control of systems that combine mechanical elements with electronic components, including computers and microcontrollers.

Subject Topics

1. **Analog and Digital Circuits. Microprocessors and Microcontrollers**: Characteristics of analog circuits and components. Operational amplifiers. Semiconductor electronic devices in digital circuits. Digital logic circuits. Basic components in microcontrollers. Data acquisition and microcontroller interfaces. Basic concepts in control software.
2. **Sensors and Actuators**: Sensor performance and selection. Principles of operation of sensors. Actuator performance and selection for mechatronic applications.
3. **Feedback Controllers**: Transfer functions on mechatronic control. P, PI and PID control. Controller simulation in Matlab/Simulink. Effects of non-linearities in mechatronic control.
4. **State Transition Diagrams in Mechatronics**: Transition and steady-state in mechatronic control. PIC interfaces with physical systems.
5. **Software Applications in Mechatronics**: Virtual instrumentation in LabView. Development of computer – microcontroller interfaces for mechatronic applications. Open-source applications on Arduino and Raspberry Pi microcontrollers. Simulation of mechatronic systems responses in Matlab.

6. **Mechatronic System Integration**: Integration of the different components of a mechatronic system such as sensors, actuators, amplifiers, interface circuits, and control software

Subject Learning Outcomes SLOs

On completion of this subject, students will be able to:

1. Evaluate analog and digital circuits, logic circuits and microcontroller interfaces. Analyze digital combinational logic circuits and generate logic circuits from a truth table specification. Draw a wiring circuit for digital devices.
2. Analyze and interpret sensor performance and select sensors for specific applications in mechatronics. Model the electro-mechanical behaviour of actuators. Explain drive methods and amplifiers for different actuators.
3. Explain differences between open- and closed-loop control systems. Derive the closed-loop transfer function of a control system. Obtain the steady-state error for first- and second-order systems under P, PI, or PID control. Explain the digital implementation of a PID controller in mechatronics. Use Matlab/Simulink to simulate closed-loop control systems. Implement and analyze the operation of state feedback controllers.
4. Apply state-transition diagrams to the operation and control of different mechatronic systems. Apply circuit design for the construction of circuits to interface PIC microcontrollers with physical systems.
5. Evaluate software for controlling mechatronic systems. Develop software for the interface between a PC and a microcontroller system. Apply modeling techniques to develop a dynamic model of a mechatronic system. Apply Matlab to simulate the response of mechatronic systems.
6. Design and evaluate the integration of the different components in mechatronic systems such as sensors, actuators, amplifiers, interface circuits, and control software
7. Undertake team laboratories and communicate team-based laboratory outcomes via well structured reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination.

Students must also refer to the Subject Assessment Details.

Assessment 1–Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4- Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total subject workload for the average student is a nominal 150 hours, based on a 15 week semester with 13 weeks of lecturing and laboratories, one mid-semester week and one examination week as per PNG National Qualification Framework.

Subject Textbook

- Jouaneh, M. - *Fundamentals of Mechatronics*, Cengage Learning, Stamford, Connecticut, United States, 2013

References

- Alciatore, D., Histand, M. – *Introduction to Mechatronics and Measurement Systems*, 4th Edition, McGraw Hill, New York, 2012

Readings and Resources

- TecQuipment – CE 110 Servo Trainer, Nottingham, United Kingdom, 2008
- TecQuipment – CE 2000 Software, Nottingham, United Kingdom, 2008

YouTube Clips

- https://www.youtube.com/watch?v=6THmFjnmvVY&list=PLbjTnj-t5GklbeqS8OMMJBrTl3DdeNn3t
- https://www.youtube.com/watch?v=qalDDp5V3ek&list=PL_uaeekrhGzJMZTb5etIdXasVO9-WVPVH
- https://www.youtube.com/watch?v=FTrg8gcB84M&list=PLtuwVtW88fOeTFS_szBWif0Mcc0lfNWaz

Relevant Unitech Policies

- It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are available at the PNGUOT website: http://asix.unitech.ac.pg/apps/pnguot/?q=unitech/policies

Course	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Integrated Mechanical Design
Subject Code	ME422
Duration	13 Teaching Weeks, 1 Examination Week, 1 Mid-semester Week
Contact Hours	6 Hours per Week (2 Hours Lectures / 4 Hours Design/Projects) – Note that significant out of class teamwork is required as seen in the allocated Credit Points
Credit Points	18
Delivery Mode	On Campus
Prerequisites	ME311 - Mechanics of Machines, ME312 - Machine Design, ME314 Manufacturing Processes and Design, ME313 Heat Transfer
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

This is a capstone design subject that builds on previous introductory and intermediate design subjects which form a backbone of the mechanical engineering program. It enables students to work in teams to undertake complex mechanical engineering design projects. The subject develops abilities regarding the design and development of complex mechanical engineering systems such as; need identification, problem definition, concept generation and evaluation, systemic implications of design decisions, understanding of design challenges and application of design established practices. It covers design theory, failure and risk analysis, estimation of life cycle costs, reliability and quality in observance of international standards. Modern design tools widely used in industry such as SolidWorks, ANSYS and MATLAB are employed. Integrated design methodologies such as Virtual Prototyping, 3D Printing, Computational Thermofluidic Dynamics, and Rapid Prototyping are considered. How engineering design decisions may be influenced by the social and economic considerations, health, safety, and environment considerations, professional ethics and sustainable life cycle is covered. The impact of poor design, imperfections in materials, improper manufacturing, poorly defined assembly and maintenance will be investigated to ensure awareness of the need of design for reliability and quality for robust design. The subject culminates with effective business approaches and a team based multimedia technical presentation.

Subject Topics

1. Fundamentals of Integrated Design
2. Communication of design intent through 3D models and related technical drawings of system's assemblies and components

3. Application of contemporary interdisciplinary evaluation tools in integrated design: CAD, Finite Element Modelling, Multi-Physics, 3D Printing and CAM
4. Integrated Design Phases:

    a. Objectives
    b. Requirements for effective design
    c. Design procedures
    d. Functions and characteristics of optimal design
    e. Alternative solutions
    f. Detail optimization

5. Design Management

    a. Strategies in integrated design and their interdisciplinary connections
    b. Product development from 3D Model to Rapid Prototype through FEM, 3D Printing, Rapid Prototyping and Prototype Testing

Subject Learning Outcomes (SLOs)

After completing this unit students will be able to:

1. Plan, manage and conceptualize a Mechanical engineering design project within requirements and constraints including requirements, time and resources using mechanical system design and analysis tools
2. Formulate concept solutions by researching, applying and synthesising the knowledge gained throughout their course. Apply problem-solving methodologies to generate, evaluate and justify proposed concept solutions.
3. Debate, negotiate, justify, clarify and respond to questions and statements concerning the proposed design concept in terms of Integration of sub-discipline applications.
4. Apply good professional engineering practice to the design project, including safety, ethical, legal, social, cultural and sustainability considerations, along with International standards and codes of practice.
5. Generate high quality product documentation incorporating literature review, design requirements, analysis, proposal conceptualization, 3D printing, concept prototyping and project planning.
6. Use design project management processes and tools, self-management skills, communication skills in order to plan and manage project work.
7. Engage in effective teamwork and communication of design outcomes.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved plus a minimum of 50% in the Final Design Report. Students must also refer to the Subject Assessment Details.

Assessment 1 – Design Project Concept Report: A team-based report outlining team formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the final design outcome. The report contributes 10% towards the final grade for the subject.

Assessment 2 – Design Progress Reports: Team based report outlining team progress in achieving design outcomes in line with the team schedule submitted in the Project Concept Report. Variations to the original schedule will be identified and justified. There will be three progress reports, each written by different members of the team. The Progress Reports contributes 15% towards the final grade for the subject.

Assessment 3 - Final Design Report: A professional level report with individual and team components that outlines and communicates the design processes, rationale and outcomes. The Final Report contributes 60% towards the final grade for the subject. Team member's grades are composed of a team component and individual component.

Assessment 4 - Audio Visual Presentation: An audio-visual presentation of design outcomes that contains the salient feature of the Final Report. All team members will contribute. The presentation contributes 15% towards the final grade for the subject. Team member's grades are composed of a team component and individual component.

Student Workload

The total workload for the subject for the average student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Texts

Budynas, RG & Nisbett, K, 2015. Shigley's Mechanical Engineering Design, 9th Edition in SI units, McGraw-Hill. ISBN: 978-981-3151-00-0.

https://www.academia.edu/13057650/Book_Mechanical_Design_9th_Edition

Childs, PRN, 2014. Mechanical Design Engineering Handbook, Elsevier.

https://www.academia.edu/35699015/Mechanical_Design_Engineering_Handbook_pdf

Reference Texts

1. Nigel Cross, 2008. *Engineering Design Methods: Strategies for Product Design*, 4th Edition, Wiley & Sons
2. Dassault Systems, 2012. *SolidWorks Fundamentals*, Concord, Massachusetts, United States, 2012
3. Cook, R, 1995. *Finite Element Modelling for Stress Analysis*, John Wiley & Sons, New York.
4. Collins, J., Busby, H., Staab, G. 2010. *Mechanical Design of Machine Elements and Machines*, Second Edition, John Willey, New Jersey.
5. Leondes, C 2001. *Systems Techniques and Computational Methods*, CRC Press, Boca Raton.

Additional Readings

1. Lecture Notes
2. Relevant Laboratory Notes

YouTube Clips

The following YouTube Clips augment weekly lectures:

1. Top 10 Steps of the Mechanical Design Process – DQDesign, https://www.youtube.com/watch?v=kZKmsJJDyn8
2. 3D Printing Basics, https://www.youtube.com/watch?v=nb-Bzf4nQdE
3. Virtual Prototyping, https://www.youtube.com/watch?v=qVoeTDrF6_0
4. CNC Milling Using Mastercam, https://www.youtube.com/watch?v=HfTb1qIR-nI
5. Overview of ANSYS Workbench for Finite Element Analysis, https://www.youtube.com/watch?v=tIBKSOy0jE4

Relevant Unitech Policies

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Course(s)	Bachelor of Mechanical Engineering (NQF Level 8)
Subject Name	Energy and Environment
Subject Code	ME423
Duration	13 teaching weeks, 1 examination week, 1 mid-semester week
Contact Hours	6 hours per week (4 Lec / 1 Tut / 1 Lab)
Credit Points	20
Delivery Mode	On campus
Prerequisites	ME211 Thermodynamics and Cycles, ME313 Heat Transfer
Co-requisites	Nil
Subject Coordinator	TBA

Synopsis

The subject covers local and global energy needs for the present and beyond in a sustainable manner. Student will become aware of limitations of traditional and non-traditional energy resources and will examine energy generations in the light of social, political, environmental and economic context

Subject Topics

1. Introduction
2. Energy conservation
3. Energy technologies and industries
4. Analysis of current energy related problems
5. Climate change, impacts, mitigation, CO2 control
6. Energy economies and policy analysis

Subject Learning Outcomes (SLOs)

On completion of this subject students will be able to:

1. Describe energy conversion processes
2. Identify and to manage energy wastage in commercial/industrial sectors
3. Design and outline and explain the need for improvements on existing fossil fuel usage
4. Undertake feasibility study on “Green” technologies
5. Reflect on climate change and its effect on world population
6. Analyse energy policy of PNG government and international policies such as Kyoto and Montreal

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text

Renewable Energy: Power for a sustainable future, Godfrey Boyle, Oxford University Press, 2012

References

Renewable Essential References: Energy and the Environment, 2nd Ed,, Rebert Ristinen and Jack Kraushaar, J. Wiley and Sons (1998)

Readings

Specific journals such as IMechE and EI

YouTube Clips

The following YouTube Clips should help augment the weekly lectures.

1. https://www.youtube.com/watch?v=ycVH_04azhw
2. https://www.youtube.com/watch?v=FQrqeeunLbU
3. https://www.youtube.com/watch?v=7xxpCTk3Zu0

Relevant Unitech Policies

It is important that all students familiarise themselves with the PNGUOT Assessment Guidelines including those on plagiarism and other relevant policies. These policies are viewed by visiting the PNGUOT website:

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Course(s):	Mechanical Engineering (NQF Level 8)
Subject Name:	Failure Analysis
Subject Code:	ME424
Duration:	13 teaching weeks, plus 1 examination week and 1 mid semester week
Contact Hours:	6 hours per week (4 Lec. / 1 Tut /1 Lab)
Credit Points:	20
Delivery Mode:	On campus
Prerequisites:	ME311 Mechanics of Machines, ME312 Machine Design, EN113 Engineering Materials and Properties
Co-requisites:	Nil
Academic Staff:	TBA

Synopsis:

The objective of this subject is to equip the students with general procedures, techniques and precautions employed in the investigation and analysis of metallurgical failures that occur in service. The subject covers failure formation; damage mechanisms (fatigue, wear, corrosion, creep and other mechanical failures); procedural approaches in failure analysis; metallographic and fractographic techniques. The primary aim of this subject is to provide detailed information on the procedures and mechanisms involved in failure analysis.

Subject Topics:

1. Introduction to failure analysis (Fundamentals of fracture – definitions, fracture modes)
2. Techniques of failure analysis.
3. Mechanical properties of materials
4. Stress versus strength
5. Brittle and ductile fracture
6. Fatigue fracture
7. Wear and corrosion
8. Impact fracture testing, ductile-to-brittle transition (DBTT), metallurgical factors affecting the DBTT.
9. Fractography

Subject Learning Outcomes (SLOs):

On completion of this subject students will be able to:

1. Acquire knowledge on general procedures, techniques and precautions in failure analysis

2. Analyse design related failures to explain the factors that cause failure with basic understanding of processing and material related failures
3. Identify the environmental sources responsible for failures and determine ways to prevent them
4. Discuss and explain how stress systems relate to fracture of ductile and brittle materials
5. Investigate typical fatigue characteristics and the basic facture modes and their characteristics involved in examining a fracture.
6. Working in teams to undertake laboratory exercises, analysing and discussing the outcomes and communicate those via professional reports.

Assessment Tasks and Weightings

To obtain a pass grade in this Subject at least 50% overall must be achieved, and at least 40% achieved in the final examination. Students must also refer to the Subject Assessment Details.

Assessment 1 – Lab/Project Concept Report: A team based or individual component report outlining individual or team formation. Team based report outlining formation and member roles, project selection, team and member action plan and a schedule of future activities to achieve the outcome. The report contributes 20% towards the final grade for the subject.

Assessment 2 – Assignments: The assignments are intended to support students achieving the learning outcomes for the Subject and will contribute 20% towards the final grade for the subject.

Assessment 3 – Class Test: The Test contributes 20% towards the final grade for the subject and evaluates progress towards achievement of learning outcomes.

Assessment 4 - Final Examination (E): The individual components of final examination enable final evaluation of achievement of learning outcomes and contribute 40% towards the final grade for the subject

Student Workload:

The total workload for the subject for the 'average' student is a nominal 150 hours, based on a 15 - week semester with 13 weeks of teaching as per the PNG National Qualification Framework.

Subject Text:

Required Texts: Donald J Wulpi, "Understanding *How components fail", American Society of Metals* (ASM), Ohio, USA, 2000.

References:

Essential References: Das, A. K., "*Metallurgy of Failure Analysis*", McGraw-Hill Book Company, New York, USA, 1996

Readings:

Recommended Books and Reference Material: Journals

YouTube Clips:

The following YouTube Clips should help augment the weekly lectures

1. https://www.youtube.com/watch?v=IwRLRiC-PZE
2. https://www.youtube.com/watch?v=t7FcK8jV2yA
3. https://www.youtube.com/watch?v=SrlYkx41wEE

Relevant Unitech Policies:

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