### DEPARTMENT OF MECHANICAL ENGINEERING

**Head of Department and Professor:**

**Pumwa, J.,** Ph.D. (Texas A&M), M.Eng. (Hons), (Wollongong), B.Eng. (PNGUT), Fellow ASME, Fellow IEPNG, CEng MIMechE

**Deputy Head of Department:**

**N’drelan. B. J.,** M.Eng. (ITB, Indonesia), BEng (QUT, Aust.), BEng (Unitech), MIEPNG, Reg Eng

**Professor:**

**Lambrache, N.** Ph.D. (Bucharest), Fellow American Institute of Physics, Fellow Optical Society of America, Fellow International Society of Optical Engineers.

**Associate Professors:**

**Senior Lecturers:**

- **Arshed, G.M.,** Ph.D. (Wichita State Univ), M.Sc. (KFUPM)
- **Wahid S, M S, Ph D (UNSW, Australia), CEng (UK)**
- **Ude A U.,** Ph D, M Eng (National Univ of Malaysia)

**Lecturers:**

- **Srivastava, H. S.,** M.Sc. (Kursk State, Russia)
- **Khallahle,J.B.,** MEngSc(UNSW), BEng (PNGUT), MIEAust.
- **Ales, S. K.,** M.Sc (Shenyang Aerospace Univ, China), M Tech (PNGUT) BEng (PNGUT) (On Study Leave)

**Principal Technical Instructors:**

- **Sirisena, E.J.K.P,** M.Sc (Southampton, U.K.), B.Sc. (Moratuwa, Srilanka), CEng, MIE (PNG)

**Senior Technical Instructors:**

- **N’drelan. B. J.,** M.Eng. (ITB, Indonesia), BEng (QUT, Aust.), BEng (PNGUT), M IEPNG, Reg Eng
- **Dunstan, S.** MTech, BEng (PNGUT) (On Study Leave)

**Acting Laboratory Manager:**

**Peter, T.,** B.Eng. (PNGUT), ASNT Level II (Radiography).

**Principal Technical Officer:**

**Kami, P.** Diploma in Mech. Eng. (LaePolytech) Eric Eng., Air Conditioning and Refrigeration (PETT)

**Senior Technical Officer:**

**Technical Officer:**

- **Kasir, M. E.,** Tradesman Mechanic (PETT)
- **Kamau, Z.** Trade Certificate (Fitter Machinist), Certificate III Mech. Eng (APTC)
- **Pebuar, R., B.Sc** (Applied Physics, PNGUT)
- **Peruka Jr, M.,** Certificate in Fitting and Machining (LaePolytech)

**Technical Assistant:**

- **Sahumlal, P.** (Temporary), National Certificate II in Fitting and Machining (LaePolytech)
- **Kami, B.,** (Temporary) Certificate in IT
- **Nii, L.,** Grade 12 Certificate.

**Artisan:**

- **Silou, D.** (Temporary) Certificate in Fitting and Machining (Polytechnic/ APTC)

**Senior Storeman:**

**Mendode, H.** Grade 10 with experience

**Senior Secretary:**

**Kapi, G.** Certificate in Stenography

**Secretary II:**

**Valuta, A.** Basic Secretarial training (Grade 12)

**VISION**

To be nationally and regionally recognized mechanical engineering department that attracts, reward, and retains outstanding students, 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, 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 experts to solve mechanical engineering problems assume leadership/managerial positions in industry, professional community and government. They should be able to enhance their academic career through advanced studies and life-long learning.

BACHELOR 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.

Regular Program
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 ABET criteria on student outcomes. Accordingly, the mechanical engineering teaching and learning efforts are focused towards 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 economic, political, ethical, social, environmental, health and safety, and sustainability. Efforts are also focused towards 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 other equivalent institution may be admitted to the second year, but will be required to complete a bridging course in Drawing, and Workshop Practice and other subject 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, 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 ten weeks of practical vocational training 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 ten weeks of approved practical training and completed diaries and satisfactory reports covering that period are necessary requirements for graduation.

Sandwich Program
An optional sandwich programme is available for students who have satisfactorily completed the third year of study. This programme is designed to provide students with industrial training and
selected academic studies for a minimum duration of 30 weeks. This will extend the time to complete the degree requirements, but will provide sponsorship as well as additional undergraduate engineering experience. Students who elect to take the sandwich option after the third year will normally require an additional year to complete the whole course. Such students are exempt from the vocational training requirement of ten weeks.

ENTRY REQUIREMENTS & PROCEDURES

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

- Major Mathematics: A
- Physics: A
- English: B
- Chemistry: B

Students with strong background in mathematics are given preference.

A total of 50 students are admitted into the first year of study consisting of both school-leavers and non school-leavers. School-leavers generally make up more than 75% of the new intake quota allocation.

Female students who have met the requirements have been admitted and have graduated over the past years and the Department is encouraging female students to study mechanical engineering.

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 TECHNOLOGY (M Tech)

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 practising engineers in industry and government bodies, and also assistant lecturers who would eventually take up teaching positions in this university. The programme is intended to function with co-operation 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 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 (PhD)

To gain entry to 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.

Normal duration for Ph.D. program is a minimum of three years on 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 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 centres, 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, centred 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 industry in the form of consultancy, personnel training and short courses on selected topics. The areas of involvement may comprise rural development including mechanisation of agricultural production, materials testing, solar energy applications, alternative fuels and renewable energy sources, including charcoal and pyrolytic liquid fuels, wind power, hydro power, production systems including manufacturing processes, plant layout, materials handling, warehouse design and operations, production planning and control, and computer-aided design and drafting.

DEPARTMENTAL ADVISORY COMMITTEE

A Departmental Advisory Committee 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

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<th>Average Code</th>
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Average Code

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* to be chosen from either LC311 Developing Communication and Communicating Development or ME303 Ethics and Engineering.

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<td>ME441</td>
<td>Project I</td>
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<td>ME451</td>
<td>Applied Fluid Mechanics I</td>
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<td>ME463</td>
<td>Vibration Analysis</td>
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<td>ME403</td>
<td>Organisational Management</td>
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Year 4 Second Semester
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<td>ME432</td>
<td>Automatic Control</td>
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<td>ME442</td>
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<td>BA484</td>
<td>Marketing for Engineers</td>
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<td>Finance for Engineers</td>
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** to be chosen from the list of subjects offered or recommended by the Department.

# Common Credit (CC) Currency. Private study for subjects varies from 1.5 to 2 hours per equivalent lecture hour. Three lab hours is taken as equivalent to one lecture hour. Total credits for the program is 737.

First Semester Electives:
| ME405 | Quality Control |
| ME407 | Management Information Systems |
| ME433 | Advanced Manufacturing |
| ME471 | Mechanical Systems Design |
| ME481 | Fundamentals of Non-Destructive Evaluation |
| ME491 | Applied Thermodynamics |

Second Semester Electives:
| ME436 | Flexible Manufacturing Systems |
| ME438 | Computer Integrated Manufacture |
| ME452 | Applied Fluid Mechanics II |
| ME472 | Design for Manufacture |
| ME474 | Design & Analysis of Mechanisms |
| ME476 | Computer-Aided Design |
| ME482 | Failure Analysis |
| ME492 | Refrigeration & Air-Conditioning |
| ME494 | Automotive Engineering |
| ME496 | Renewable Energy |
SUBJECTS TAUGHT BY THE DEPARTMENT

ME121  Introduction to Mechanical Engineering Systems
ME124  Engineering and Business Communication
ME162  Workshop Technology and Practice
ME171  Engineering Drawing I
ME172  Engineering Drawing II
ME202  Mechanical Engineering IE
ME231  Manufacturing Technology I
ME232  Manufacturing Technology II
ME252  Fluid Mechanics
ME261  Statics
ME262  Dynamics
ME266  Solid Mechanics I
ME271  Engineering Drawing III
ME276  Workshop Technology and Practice for Food Technology
ME281  Engineering Materials I
ME291  Thermodynamics I
ME292  Thermodynamics for Food Technology
ME302  Production/Operations Management
ME303  Ethics and Engineering
ME311  Experimental Engineering I
ME313  Industrial Training I *
ME314  Industrial Training II *
ME336  Engineering Analysis for Mechanical Engineers
ME361  Solid Mechanics II
ME362  Mechanics of Machines
ME371  Machine Element Design I
ME372  Machine Element Design II
ME381  Engineering Materials II
ME391  Thermodynamics II
ME393  Heat Transfer
ME401  Mechanical Engineering Systems IIE
ME402  Maintenance Engineering
ME403  Organisational Management
ME405  Quality Control
ME407  Management Information Systems
ME411  Experimental Engineering II
ME422  Vocational Training *
ME432  Automatic Control
ME433  Advanced Manufacturing
ME436  Flexible Manufacturing Systems
ME438  Computer-Integrated Manufacture
ME441  Project I
ME442  Project II
ME452  Applied Fluid Mechanics II
ME463  Vibration Analysis
ME471  Mechanical Systems Design
ME472  Design for Manufacture
ME474  Design & Analysis of Mechanisms
ME476  Computer-Aided Design
ME481  Fundamentals of Non-Destructive Evaluation
ME482  Failure Analysis
ME491  Applied Thermodynamics
ME492  Refrigeration & Air-Conditioning
ME494  Automotive Engineering
ME496  Renewable Energy

* Supervised jointly with Industry.

SUBJECT DETAILS

ME121  INTRODUCTION TO MECHANICAL ENGINEERING

Credit Points: 8
Contact hours: (1-2) per week
Private study: 6 hours per week
Pre-requisite: None

Learning Outcomes
The objective of this subject is to provide an overview of the broad field of mechanical engineering, and to enable freshman students an appreciation/understanding of mechanical engineering systems, system components, and their associated functional principles.

By the end of the subject, students should be able to:

1. Recognize the scope of mechanical engineering
2. Distinguish between program objectives and program outcomes
3. Understand the importance of communication, teamwork, interpersonal skills, and time management.
4. Recognize ethical issues in engineering
5. Recognize political, economic and cultural issues
6. Understand the impact of engineering on the environment
7. Understand the working principles of system such as engines, boilers, turbines, compressors, machine
8. tools, hydraulic and pneumatic systems, robots, etc.;
9. Understand how various components of a system work to produce useful functions;
10. Understand the shape, size and material of various components;
11. Understand the role of fasteners.
12. Write short assignment reports on relevant topics
13. Improve on self-learning

**Syllabus:**
Scope of mechanical and other main engineering disciplines; mechanical engineering program educational objectives; program outcomes - communication, teamwork, interpersonal skills, and time management; entrepreneurial engineer; global engineer; new technologies; ethical issues, sustainability (environment), current political, economic and cultural issues.
Functional principles of systems such as petrol and diesel engines, micro-hydro, boilers, turbines (steam and gas), air compressors, pumps, CNC machines, EDM machines and robots; study of mechanisms such as slider-crank mechanism, cam mechanism; hydraulic and pneumatic systems; study of shapes, size and materials of system components such as shafts, pulleys, gears, sprockets, chains, belts, bearings, springs; automotive parts: piston rings, connecting rods, crank shafts, couplings, brakes, gaskets, seals, etc; various types of fasteners: screws, bolts, nuts, keys, rivets, welding, glue, etc; individual and group projects; seminar presentation.

**Textbook:**
Departmental course notes

**References:**
Mechanical Engineering and Plant Engineering Handbooks

**Internet**

**Assessment:**
Continuous assessment – 100%

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**ME124 ENGINEERING AND BUSINESS COMMUNICATION**

Common Credit: 14

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**ME162 WORKSHOP TECHNOLOGY AND PRACTICE**

Common Credit: 8
Hours Per Week: 3 (1/2)
Learning Outcomes:
On completion of the subject, students should be able to:
1. Understand different types of metallic materials and their properties.
2. Be familiar with various metallic manufacturing processes such as machining, welding, fabricating, casting, etc.
3. Be familiar with various measuring instruments and their applications.
4. Understand how various machine tools operate and be able to operate them.

Syllabus:

Measurement: slip gauges, comparator, vernier height gauge, micrometer, vernier caliper, roughness measurement, etc.


Use of hand tools. Use of machine tools: lathe, milling, shaping, drilling, and grinding.

Textbook:

Reference:

Assessment:
Continuous assessment - 100%

ME 171 ENGINEERING DRAWING I

Credit Points:  8
Contact hours: (1-2) per week

Private study:  6 hours per week
Pre-requisite:  None

Learning Outcomes
On completion of the subject, students should be able to:
LO1: Read, understand, and produce engineering drawings
LO2: Read, understand, and apply different projections to engineering drawings
LO3: Make freehand sketches of engineering shapes.
LO4: Apply dimensions and limits to views
LO5: Make assembly drawing

Syllabus:
Introduction to engineering drawing; freehand sketching; oblique and isometric drawing; visualization practice; orthographic projections (1st and 3rd angle); sectioning; dimensioning; limits, fits and tolerance; assembly drawing; computer aided drawing.

Textbook:

James D. Bethune, Engineering Graphics with AutoCAD 2015


Reference Books


Assessment:
Continuous assessment – 100%

ME 172 ENGINEERING DRAWING II

Common Credit: 8
Hours per week: 3(1/2)

Prerequisite: ME 171

Learning Outcomes:
On completion of the subject, students should be able to:
1. Understand and apply the concepts of limits, fits, and tolerances;
2. Make pictorial drawings;
3. Make assembly drawings and details drawings using standards and conventions;
4. Learn computer-aided drafting.

Syllabus:
Limits and fits; simple detail and assembly drawing; perspective drawing; welding symbols; pipe and structural drawing; electrical & electronic drafting symbols, circuit diagrams; logic diagrams, printed circuit diagrams; standards and conventions; introduction to computer-aided drafting.

Textbook:

Assessment:
Continuous assessment - 100%

ME 202 MECHANICAL ENGINEERING IE

Common Credit: 14
Hours per week: 3
Prerequisite: PH141, PH142

Learning Outcomes:
To provide Electrical Engineering students with a broad background in Statics, Dynamics, Mechanics of Machines, Strength of Materials, Fluid Mechanics and Thermodynamics. On completion of the subject, students should be able to solve elementary problems in the topics listed above.

Syllabus:

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME 231 MANUFACTURING TECHNOLOGY I

Common Credit: 14
Hours per week: 3
Prerequisite: ME161

Learning Outcomes:
On completion of the subject, students should be able to:
1. State basic working principles, process capabilities, and scope of the application of a common range of manufacturing processes and processing machines.
2. Explain the basic concepts in casting, welding, machining, bulk deformation and forming processes and their applications.

Syllabus:
Casting processes: Furnaces and melting practice, pattern making, moulds, and casting types.
Joining processes: Mechanical joining methods, welding types, brazing and soldering.
Machine processes: Cutting tools, machine tools, and process cutting surfaces.
Bulk deformation processes: Forging, rolling, and extrusion. Sheet metal forming: Shearing, bending and blanking.
Plastic forming and shaping: Injection molding, blow molding and rotational molding and thermoforming.
ME 232 MANUFACTURING TECHNOLOGY II

Common Credit: 14
Hours per week: 3
Prerequisite: ME 231

Learning Outcomes:
On completion of the subject, students should be able to:
1. Describe operations and equipment for the conversion of raw materials into products, through material removal.
2. Identify geometric features to be measured, and apply principles of allocation of tolerance to products.
3. Plan and perform measurements at specified levels of accuracy on discrete product components.
4. Calibrate instruments and minimize the sources of errors in measurement.

Syllabus:
Conventional methods of material removal (cutting tools, cutting fluids, tool wear, grinding, machining variables, machining costs).
Non-conventional methods of material removal (chemical machining, Electrical discharge machining, laser-beam machining)
Metrology and precision measurements (calibration, measurement methods and measuring machines, inspection)
Tolerancing (size control, tolerance control of dimensions and form).

Textbook:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME252 FLUID MECHANICS

Common Credit: 18
Hours per week: 4

Learning Outcomes:
To introduce students to basic concepts of Fluid Mechanics in order to prepare them for applications in later years. On completion of the subject, students should be able to:
1. Solve problems involving pressures and forces in hydrostatic systems, and problems involving basic equations of fluid dynamics applied to pipe flow;
2. Discuss measuring devices, and common dimensionless parameters.

Syllabus:
Fluid Statics: Physical properties of fluids, manometry, hydrostatic forces on submerged surfaces, buoyancy and stability of bodies in fluids.
Fluid Dynamics: Basic concepts of ideal flow, applications of continuity equation, Bernoulli and momentum equations introduction to turbo machinery, flow measuring devices, laminar and turbulent flow, head loss in pipes, common dimensionless parameters used in fluid mechanics, and their applications.

Textbook:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

ME 261 STATICS

Common Credit: 14
Hours per week: 3
Prerequisite: PH141

Learning Outcomes:
On completion of the subject, students should be able to:
1. Apply principles of statics to engineering problems.
2. Analyse forces acting on rigid bodies at rest as a preliminary step to solving design problems.

**Syllabus:**
Force Systems:
Two-dimensional force systems: Rectangular components, Moments, Couple, Resultants.
Three-dimensional force systems: Rectangular components.
Equilibrium: Equilibrium in two dimensions: Mechanical system isolation, Equilibrium conditions
Equilibrium in three dimensions.
Structures:
Plane trusses, Method of joints, Method of sections, Frames and machines.
**Distributed Forces:**
Center of mass, Centroids of lines, Centroids of areas, Centroids of volumes, Composite bodies and figures, Beams – external effects, Beams – internal effects: Bending-moment diagram.
Friction: Mechanism of friction, Types of friction problems.
Area Moments of Inertia: Rectangular and polar moments of inertia, Radius of gyration, Transfer of axes, Composite areas, Products of inertia, Transfer of axes, Rotation of axes, Mohr’s circle of inertia.

**Textbook:**

**Assessment:**
Continuous assessment - 60%
Final examination - 40% (1 x 2 hours)

**ME262 DYNAMICS**

**Common Credit:** 18
**Hours per week:** 4
**Prerequisite:** ME261

**Learning Outcomes:**
On completion of the subject, students should be able to:
1. Apply principles of dynamics to engineering problems.
2. Analyse forces acting on rigid bodies in motion, and motion of bodies under the action of forces, as a preliminary step to solving design problems.

**Syllabus:**
Kinematics of particles:
Rectilinear motion, Graphical representation of the equations, Plane curvilinear motion, Rectangular coordinates, Normal and tangential coordinates, Polar coordinates, Relative motion (Translating axes).
**Kinetics of particles:**
Newton’s second law, Rectilinear motion, Curvilinear motion, Work & kinetic energy, Power, Efficiency, Potential energy, Impulse and momentum, Relative motion (Constant-velocity translation systems).
**Plane kinematics of rigid bodies:**
Categories of plane motion of a rigid body, Rotation, Relative velocity, Instantaneous center of zero velocity, Relative acceleration.

**Plane kinetics of rigid bodies:**
General equations of motion, Analysis procedure, Translation, Fixed-axis rotation.

**Textbook:**

**Assessment:**
Continuous assessment - 60%
Final examination - 40% (1 x 2 hours)

**ME266 SOLID MECHANICS I**

**Common Credit:** 14
**Hours per week:** 3
**Prerequisite:** ME261, ME281

**Learning Outcomes:**
To develop an understanding of the more advanced concepts in solid mechanics, and the analysis of two-dimensional and three-dimensional loading conditions. On completion of the subject, students should be able to:
1. Analyze advanced problems in bending;
2. Apply energy techniques for determining;
3. Deformation;
4. Analyze 2D and 3D stresses;
5. Analyze the stability of columns.

**Syllabus:**
Introduction – Concept of Stress:
Brief review of Forces and Stresses, Normal stress, Shearing stress, Bearing stress in connections, Application to the analysis of simple structures, Stress on an oblique plane under axial loading, Stress under general loading conditions, Ultimate and allowable stress.

Stress and Strain – Axial Loading:
Brief review of Normal strain under axial loading, Stress-strain diagram, Hooke’s law, Deformations of members under axial loading, Statically indeterminate problems, Problems involving temperature changes, Poisson’s ratio, Generalized Hooke’s law, Shearing strain, Relation among $E$, $v$ and $G$, Saint-Venant’s principle, Stress concentrations.

Torsion:
Preliminary discussion of the stresses in a shaft, Deformations in a circular shaft, Stresses in the elastic range, Angle of twist in the elastic range, Statically indeterminate shafts, Design of transmission shafts.

Pure Bending:
Preliminary discussion of the stresses in pure bending, Deformations in a symmetric member in pure bending, Stresses and deformations in the elastic range, Deformations in a transverse cross section, Bending of members made of several materials.

Transverse Loading:
Transverse loading of prismatic members, Basic assumption regarding the distribution of the normal stresses, Determination of the shear on a horizontal plane, Determination of the shearing stresses in a beam, Shearing stresses in common types of beams.

Design of Beams for Strength:
Basic considerations for the design of prismatic beams, Shear and bending-moment diagrams, Relations among load, shear, and bending moment, Design of prismatic beams.

Deflection of Beams by Integration:
Deformation of beam under transverse loading, equation of the elastic curve.

Textbook:

Assessment:
Continuous assessment - 60%
Final examination - 40% (1 x 2 hours)

ME271 ENGINEERING DRAWING III

Common Credit: 8
Hours per week: 3(1/2)
Prerequisite: ME172

Learning Outcomes:
To introduce students to the principles of engineering drawing for mechanical engineering purposes. On completion of the subject, students should be able to:
1. Make quick sketches of machine parts and components in oblique, isometric, and orthogonal projections.
2. Recognize machine units and components
3. Prepare engineering drawings using standards and conventions.
4. Apply tolerances, surface finish, and various joining methods.
5. Use computer-aided drawing.

Syllabus:
Sketching: Freehand pictorial drawing of mechanical components in oblique, isometric and orthogonal projection.
Auxiliary views: Primary and secondary.
Engineering drawing: 3rd angle projection, assembly and detail drawing.
Conventions: Joining methods, dimensioning, tolerancing, surface finish, representation of common components.
Computer aided drawing.

Textbook:
To be specified.

Reference:

Assessment: Continuous assessment – 100%
ME 276 WORKSHOP TECHNOLOGY AND PRACTICE FOR FOOD TECHNOLOGY

Common Credit: 6
Hours per week: 2

Learning Outcomes:
On completion of the subject, students should understand engineering drawing concepts, conventions and practices and become familiar with basic tools and machines in a mechanical engineering workshop.

Syllabus:
Orthographic projection using first and third angles; types of lines; dimensioning; sectioning; assembly and detail drawings; pictorial drawing; introduction to hand tools and measuring tools; conventional machine tools; manufacture of a small assembly related to food technology equipment.

Textbook:
Departmental course notes

Assessment:
Continuous assessment - 100%

ME281 ENGINEERING MATERIALS I

Common Credit: 14
Hours per week: 3
Corequisite: ME261

Learning Outcomes:
To develop an understanding of the structure of Materials, mechanical, optical, thermal, magnetic and electrical, properties of solids, and the methods used for material testing. On completion of the subject, students should understand:
1. The crystal structure of materials;
2. Mechanical, optical, thermal, magnetic and electrical Properties of materials;
3. The difference in their properties of metals, polymers, ceramics and composites in terms of bonding and crystal structure;
4. Material testing methods;
5. Crystalline imperfections and their relation to plastic deformation and strain hardening;
6. The microstructures of basic alloy systems and their properties.

Syllabus:
Mechanical optical thermal magnetic and electrical properties of materials; differences in properties of metals, polymers, ceramics and composite materials in terms of bonding and crystal structure and material testing methods. Atomic and crystal structures its relation-ship to mechanical properties. An attempt should be made for students to study various simple machine items such as lawn mower engines or bicycles etc. after dismantling them. These should enable them to understand why various materials are used in different parts of the engine or systems. Crystal imperfections and deformation by slip, plastic deformation and strain hardening. The iron-carbon equilibrium diagram. Basic types of thermal equilibrium phase diagrams of binary alloy.

Textbook:

Assessment:
Continuous assessment - 60%
Written examinations - 40% (1 x 2 hours)

ME291 THERMODYNAMICS I

Common Credit: 14
Hours per week: 3

Learning Outcomes:
To introduce students to the subject of Thermodynamics and in particular to the First Law of Thermodynamics, and to provide techniques necessary for analysis and design in later years. On completion of the subject, students should be able to solve problems, which require them to apply:
1. Basic equations derived from the First Law;
2. Gas laws, and vapour tables and diagrams;
3. Gas mixture laws;
4. Basic principles of combustion;
5. Thermodynamic principles of heat engines and refrigeration systems.

Syllabus:
Basic concepts and definitions: intensive and extensive properties, system, reversibility, work, heat, thermal equilibrium and Zeroth law of
thermodynamics.

First law of thermodynamics: conservation of energy, non-flow and steady flow energy equations.

Working fluids: liquid, vapour, vapour tables and diagrams, perfect gas, gas laws, gas mixture laws.

Reversible processes: non-flow and steady flow.

Fuels and combustion: basic chemistry, common fuels and their properties, combustion equations, exhaust gas analysis.

Thermal systems: first law treatment of turbines, compressors, engines, and refrigeration systems.

**Textbook:**

**Reference:**

**Assessment:**
Continuous assessment - 60%
Written Examinations - 40% (1 x 2 hours)

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**ME292 THERMODYNAMICS FOR FOOD TECHNOLOGY**

**Common Credit:** 14
**Hours per week:** 3

**Learning Outcomes:**
To introduce Food Technology students to the subject of Thermodynamics and in particular to the First Law of Thermodynamics, and to provide some application techniques. On completion of the subject, students should be able to solve problems, which require them to apply:

1. Basic equations derived from the First Law;
2. Vapour tables and diagrams;
3. Thermodynamic principles of heat engines, refrigeration systems, and psychrometry.

**Syllabus:**
First Law: Conservation of energy, non-flow and steady-flow energy equations.

Working Fluid: Liquid, vapour, vapour tables and diagrams.

Reversible Processes: Non-flow and steady-flow.

Thermal Systems: First Law treatment of engines, compressors, and refrigeration systems; psychrometry and cooling towers.

**Textbook:**

**Reference:**

**Assessment:**
Continuous Assessment - 60%
Written Examinations - 40% (1 x 2 hours)

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**ME302: OPERATIONS MANAGEMENT**

**Credit Points:** 14
**Contact hours:** (3-0) per week
**Private Study:** 6 hours per week
**ABET Credit:** 3
**Pre-requisite:** None

**Learning Outcomes**
By the end of the subject, students should be able to:

1. Define key terminologies in Operations Management (OM)
2. Learn principles and concepts of OM
3. Apply OM concepts and techniques
4. Make use of Excel templates to solve problems
5. Analyze OM cases
6. Write short reports on relevant topics
7. Formulate OM plans and schedules
8. Develop interpersonal skills through teamwork
9. Learn ethical issues pertaining to OM
10. Improve on self-learning

**Syllabus**
This subject is intended to introduce students to the field of operations/production management. The topics covered in this subject include both
strategic management issues and practical applications. Specific topics include introduction and scope of operations management; strategic management, competition and productivity; forecasting; strategic capacity planning; process selection and facility layout; management of quality and quality control; aggregate planning and scheduling; MRP and ERP; inventory management; JIT and lean production; supply chain management; scheduling; project management; management of waiting lines; linear programming.

Textbook
(b) Online resource: www.mhhe.com/stevenson12e

Reference:
(b) Journals: Harvard Business Review

Assessment Strategies:
(i) Continuous Assessment:
   a. Quiz 15%
   ii. Assignments 30%
   iii. Tests 30%
(ii) Final Exam 25%(1 x 2-hr) Total 100%

ME 303 - ETHICS AND ENGINEERING

Common Credit: 14
Hours per week: 3
Prerequisite: Nil

Learning Outcomes:
The objective of the subject is to equip the students with ethical issues and professional codes of ethics that are encountered in the course of engineering practice for familiarity and awareness. On completion of the subject, students should be aware and familiar with:
1. The code of ethics for engineers, the fundamental principles and rules of practice including the professional obligations.
2. The nature of the ethical problems that are encountered in the engineering practice.
3. How an engineer manages ethical problems.
4. The distinction between personal ethics and professional, or business ethics.
5. The required professionalism and code of ethics and attitudes for an engineer.
6. The interdisciplinary boundaries on ethical issues
7. The engineer’s role in multi-disciplinary issues

Syllabus:
Code of ethics for engineers, the fundamental principles and rules of practice, professional obligations. Contract Law principles, engineering and construction contracts, professional liability, Positive attitude formation and development of techniques of moral analysis and their application to ethical problems encountered by engineers, such as professional employee rights and whistle blowing; environmental issues; ethical aspects of safety, risk and liability and conflicts of interest; emphasis on developing the capacity for independent ethical analysis of real and hypothetical cases and case studies involving the ethical issues. Emphasizes will be on developing a code of ethics relating to wantok system, development issues and general work ethics for national engineers.

Textbook:

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME 311 EXPERIMENTAL ENGINEERING I

Common Credit: 8
Hours per week: 1.5

Learning Outcomes:
To develop and equip students with the skills to plan, design and conduct experiments and to be familiar with various application of basic measurement techniques and instrumentation to
conduct experimental investigation of mechanical engineering systems. On completion of the course, the student should be able to:

1. Formulate an experimental plan including precise statement of problems to be solved etc.
2. Show familiarity with various experimental procedures, analysis and reporting of results.
3. Identify and select factors to be used in an experiment including the parameters to be measured.
4. Understand full factorial and fractional factorial experiments.
5. Develop skills in Technical Communications in the presentation of experimental results (report, letters, memos, etc.) and public speaking (talks, seminars, etc.).
6. Verify relevant theory studied in various subjects.
7. Demonstrate the understanding of how theory applies to relevant industrial plant.

**Syllabus:**
Introduction; objectives of design of experimentation, the design of experiments process; overview of basic statistical concepts, techniques and procedures; full factorial and fractional factorial experiments. Measurement system design and application; technical communications; written reports covering the planning, execution, results and conclusions of the investigations.

Laboratory sessions on mechanical engineering systems to supplement the course material such as materials testing, engines, turbines, manufacturing methods, flow and heat transfer devices, mechanical systems (ME232, ME252, ME261, ME262, ME281, ME291, ME381).

**Textbooks:**

Department Laboratory Manual or handouts

**Reference:**

**Assessment:**
Continuous assessment - 100%

**ME 313  INDUSTRIAL TRAINING I**
(SANDWICH COURSE ONLY)

**Common Credit:** 0

**Duration:**
A period of 15 weeks of approved attachment to one or more engineering based industries, accumulated after successful completion of Year 3 regular program.

**Learning Outcomes:**
On completion of the subject, students should have gained:
1. Hands-on training in the practical aspects of mechanical engineering;
2. Appreciation and practical skills of communication within the workforce;
3. Experience in the day-to-day management of working life;
4. Skill in applying theoretical knowledge to practical situations.

**Syllabus:**
Depending on the organisation’s structure and areas of involvement, students should cover most if not all of the following: Practical aspects of planned and emergency maintenance, design, modification and installation, workshop processes, plant operation, testing and experimentation, power generation, electrical installation and maintenance, stock control, budgeting and financial control.

**Assessment:**
Diaries and reports as prescribed by the Department.

**ME314  INDUSTRIAL TRAINING II**
(SANDWICH COURSE ONLY)

**Common Credit:** 0

**Duration:**
A period of 15 weeks approved attachment to one or more engineering-based industries, accumulated after successful completion of ME313.
Learning Outcomes:
On completion of the subject, students should have gained:
1. Hands-on training in the practical aspects of mechanical engineering;
2. Appreciation and practical skills of communication within the workforce;
3. Experience in the day-to-day management of a working life;
4. Skill in applying theoretical knowledge to practical situations.

Syllabus:
Depending on the organisation’s structure and areas of involvement, students should cover most if not all of the following: Practical aspects of planned and emergency maintenance, design, modification and installation, workshop processes, plant operation, testing and experimentation, power generation, electrical installation and maintenance, stock control, budgeting and financial control.

Assessment:
Diaries and reports as prescribed by the Department.

ME 336 ENGINEERING ANALYSIS FOR MECHANICAL ENGINEERS

Common Credit: 14
Hours per week: 3
Prerequisite: Nil

Learning Outcomes:
Introduce students to numerical methods for solving engineering problems. On completion of the subject, the student should be able to:
1. Select appropriate numerical methods for a given engineering problem.
2. Set-up the numerical methods and verify with hand calculations.
3. Write programs to numerically solve engineering problems using various available software.

Syllabus:

Textbook:

References:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME361 SOLID MECHANICS II

Common Credit: 14
Hours per week: 3
Prerequisite: ME266

Learning Outcomes:
To develop an understanding of the more advanced concepts in solid mechanics, and the analysis of two-dimensional and three-dimensional loading conditions.
On completion of the subject, students should be able to:
1. Analyze advanced problems in bending;
2. Apply energy techniques for determining deformation;
3. Analyze 2D and 3D stresses;
4. Analyze the stability of columns.

Syllabus:
Pure bending – Advanced topics: Unsymmetric
bending, Bending of curved members

Transformations of stress and strain:
Transformation of plane stress, Principal stresses, Maximum shearing stress, Mohr’s circle for plane stress, General state of stress, Application of Mohr’s circle for stress to the 3D analysis of stress, Yield criteria for ductile materials under plane stress, Fracture criteria for brittle materials under plane stress, Stresses in thin-walled pressure vessels, Transformation of plane strain, Mohr’s circle for plane strain, Measurements of strain, strain rosette

Energy method: Strain energy, Strain-energy density, Elastic strain energy for normal stresses, Elastic strain energy for shearing stresses, Work and energy Work and energy under several loads, Castigliano’s theorem

Columns: Stability of structures, Euler’s formula for pin-ended columns

Textbook:

Assessment:
Continuous assessment - 60%
Final examination - 40% (1 x 2 hours)

ME 362 MECHANICS OF MACHINES

Common Credit: 18
Hours per week: 4
Prerequisites: ME 261, ME 262

Learning Outcomes:
To introduce the students to the study of Mechanics of Machines. On completion of the subject, students should be able to:

1. Construct velocity and acceleration diagrams for machine components.
2. Determine the forces (static and dynamic) acting on the components of a machine in operation.
3. Analyze the dynamics of a system to produce a specified motion.

Syllabus:

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME371 MACHINE ELEMENT DESIGN I

Common Credit: 14
Hours per week: 3
Prerequisite: ME266

Learning Outcomes:
To introduce students to the concepts of machine design and teach them how to design basic mechanical engineering components. On completion of the subject, students should be able to:

1. Explain the process of the design of machine elements,
2. Develop analytical skills in designing simple machine elements.

Syllabus:

Textbook:

Reference book:
Shigley, J.E. ,Mischke C.R. and Budynas R.G,
ME372  MACHINE ELEMENT DESIGN II

Common Credit: 14
Hours per week: 3
Prerequisite: ME371

Learning Outcomes:
To introduce students to advanced design topics and teach them how to design selected mechanical engineering components. On completion of the subject, students should be able to:
1. Further develop analytical skills in machine element design,
2. Design simple machines and components,
3. Further develop skills in engineering drawing, both manual and computer-aided.

Syllabus:

Textbook:

Reference book:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)
ME 386: ENGINEERING ECONOMY

Credit Points: 14
Contact hours: (3-0) per week
Prerequisite: None

Learning Outcomes
On completion of the subject students should be able to:

1. Define and use key terminologies, and learn principles and concepts of engineering economy
2. Apply key concepts and principles to solve typical practical engineering economy problems within the context of international economic issues.
3. Analyze problems in some depths including relevance, advantages, limitations to make informed decisions
4. Write short reports on relevant topics
5. Make use of MS Office Excel Templates to solve engineering economy problems
6. Formulate business economy plans
7. Display professional performance in terms of appearance, punctuality, normal courtesy to others and teamwork.
8. Learn of the ethical framework and ethical issues in engineering economics (http://www.scu.edu/ethics/practicing/decision/framework.html)

Textbook:

Assessment:
Continuous assessment - 60%
Written examinations - 40% (1 x 2 hours)

Assessment Strategies:
(i) Continuous Assessment:
   i. Quiz 15 %
   ii. Assignment 15 %
   iii. Tests 30 %
(ii) Final Exam 40%
Total 100%

ME391 THERMODYNAMICS II

Common Credit: 14
Hours per week: 3
Prerequisite: ME291

Learning Outcomes:
To introduce the students to the Second Law of Thermodynamics and some of its consequences, and to further develop understanding of gas power, vapor power and refrigeration cycles. On completion of the subject, students should be able to:

1. Discuss the construction and performance of internal combustion engines;
2. Discuss the Second Law of Thermodynamics and the concept of entropy;
3. Analyze the thermodynamics of internal combustion engines, compressors, steam power plant, and solve related problems.

Syllabus:
Reviewing the First Law of Thermodynamics with applications to internal combustion engines and compressors, using the non-flow and steady flow

**Textbook:**

**Reference:**

**Assessment:**
Continuous - 60%
Written Examination - 40% (1 x 2 hours)

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**ME393 HEAT TRANSFER**

**Common Credit:** 14
**Hours per Week:** 3
**Prerequisite:** ME291

**Learning Outcomes:**
To introduce to the students basic concepts of heat transfer processes and techniques for analyzing and designing related systems. On completion of the subject the students must be able to:
1. Discuss basic concepts of conduction, convection, and radiation, combined modes of heat transfer.
2. Solve the one-dimensional problem in convection and conduction.
4. Solve heat exchanger problems.

**Syllabus:**
Concept of heat and conservation of energy: heat transfer modes: conduction, convection and radiation. Development of the general heat conduction equation from basic principles of energy conversation.
Forced convection: External Flow: dimensionless numbers, laminar and turbulent flow over flat plate.
Flow over single circular, non-circular cylinders, and spheres. Internal Flow: Fully developed laminar flow.
Free convection: dimensionless numbers, flow over flat plate, long cylinder, sphere, and enclosed spaces.
Heat Exchangers: Classifications and Temperature distribution. Overall heat transfer coefficient and LMTD method. LMTD Correction, ε-NTU Method.

**Textbooks:**

**References:**

**Assessment:**
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

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**ME401 MECHANICAL ENGINEERING SYSTEMS IIE**

**Common Credit:** 9
**Hours per Week:** 2
**Prerequisite:** ME202
Learning Outcomes:
To familiarize the Electrical Engineering students with mechanical systems and their operating principles used in power generation. On completion of the subject, students should be able to:
1. Calculate heat exchanger parameters, and describe their characteristics;
2. Calculate thermal and hydroelectric power plant parameters and describe their various mechanical components.

Syllabus:
Review of heat transfer, thermodynamics and fluid mechanics principles. Application to heat exchanger systems, and any three of the following: gas and steam turbines, diesel engines, steam power plant, hydro power plant.

Textbook:
Departmental course notes

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME402 MAINTENANCE ENGINEERING
Common Credit: 14
Hours per week: 3

Learning Outcomes:
To introduce students to the basic concepts of maintenance engineering and particularly that of preventive maintenance. On completion of the subject, students should be able to:
1. Compare the costs of different types of maintenance;
2. Design a lubrication program, inspection programme and scheduling;
3. Design work order forms;
4. Establish a preventive maintenance programme.

Syllabus:
Fundamentals of maintenance, maintenance costs, codes and inventories, recording of machine history, lubrication and lubrication programme, inspection procedures, maintenance planning and scheduling, work order system, typical maintenance procedures, condition-based maintenance, computerized maintenance, building maintenance, queuing theory.

Textbooks:
To be specified.
Departmental course notes

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME403 ORGANIZATIONAL BEHAVIOR
Credit Points: 14
Contact hours: (3-0) per week
Pre-requisite: None

Learning Outcomes
By the end of the subject, students should be able to:
1. Define key terms in Organizational behavior (OB)
2. Learn principles and concepts of OB
3. Apply OB concepts and techniques
4. Learn new OB issues in international context
5. Analyze OB cases
6. Write short assignment reports on relevant topics
7. Develop interpersonal skills through teamwork
8. Learn ethical issues pertaining to OB
9. Improve on self-learning

Syllabus
This subject is intended to introduce students to the field of organizational behavior. The topics covered in this subject include both strategic management issues and practical applications.

Specific topics include introduction and scope of
organizational behavior; diversity in organization; attitude and job satisfaction; personality and values; motivation; group behavior and team work; communication; leadership; power, politics and conflict resolution; organizational structure; organizational culture; human resource policies and practice; organizational change; ethical issues in organizational behavior.

Textbook
(b) Online resource: www.pearsonhighered.com

Assessment Strategies:
(1) Continuous Assessment:
   i. Quiz 15 %
   ii. Assignments 30 %
   iii. Tests 30 %
(2) Final Exam 25%(1 x 2-hr)

ME405 QUALITY CONTROL

Common Credit: 14
Hours per week: 3
Prerequisite: MA 339

Learning Outcomes:
To introduce students to the basic quantitative methods for quality control in industry. On completion of the subject, students should be able to:
1. Apply various statistical techniques for quality control;
2. Apply quality assurance and reliability;
3. Apply sampling inspection methods.

Syllabus:
Introduction to quality control, statistical approaches: frequency distribution, cause and effect diagram, Pareto diagram, check sheets, correlation diagram, control charts, process analysis and improvement, process capability, process control, quality assurance and inspection, quality assurance methods, reliability, inspection methods, sampling inspection.

Textbook:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME407 MANAGEMENT INFORMATION SYSTEMS

Common Credit: 14
Hours per week: 3
Prerequisite: ME 334

Learning Outcomes:
On completion of the subject, students should be able to:
1. Understand how information is managed;
2. Identify different types of information systems;
3. Understand the design and implementation of information systems;
4. Understand how data communication systems work;
5. Describe the functionality and logic used in Database technology;
6. Use a micro-computer-based database package.

Syllabus:

Textbook:
To be specified.

Assessment:
Continuous Assessment - 60%
Written Examinations - 40% (1 x 2 hours)
ME 411 EXPERIMENTAL ENGINEERING II

Common Credit: 8
Hours per week: 3 (1/2)

Learning Outcomes:
To develop and equip students with the skills to plan, design and conduct experiments, analyze and interpret data for trends and draw meaningful conclusions from the results and to be familiar with various applications of basic measurement techniques and instrumentation for conducting experimental investigation of mechanical engineering systems. On completion of the course, the student should be able to:

1. Plan and conduct an experiment on their own for investigating a problem.
2. Choose and select appropriate experimental designs for various experimental applications.
3. Formulate a model including the mathematical model that describes the observations anticipated under the experiment plan.
4. Familiarize and understand the Taguchi method of Orthogonal Array selection
5. Develop an ability to analyze and interpret experimental data and draw up meaningful conclusions
6. Demonstrate and verify relevant theory studied in various subjects and understand how theory applies to relevant industrial plant.

Syllabus:
Overview of full factorial and fractional factorial experiments, introduction to Taguchi method, Orthogonal Array (OA) selection an utilization; examples of the use of OA such as L4, L8 and L9 matrices, analysis and interpretation methods for experiments; analysis of variance (ANOVA); introduction to quality engineering; applications of design of experiments in the improvement of manufacturing processes.

Laboratory sessions on mechanical engineering systems to supplement the course material such as materials testing, engines, turbines, refrigeration systems, flow and heat transfer devices, boilers, mechanical vibration, NDE and mechanical systems (ME391, ME393, ME451, ME463, ME362, ME481, ME491).

Textbooks:
1. Ross, J. Phillip, Taguchi Techniques for Quality Engineering, Loss Function,
3. Department Laboratory Manual or handouts

Reference:

Assessment:
Continuous assessment - 100%

ME422 VOCATIONAL TRAINING (REGULAR COURSE ONLY)

Common Credit: 0

Duration:
Periods of up to a total of ten (10) weeks of approved attachment to one or more engineering-based industries normally accumulated during the vacations following completion of the second and third years of study.

Learning Outcomes:
On completion of the subject, students should have gained:
1. Hand-on-training in the practical aspects of mechanical engineering;
2. Appreciation and practical skills of communication within the workforce;
3. Experience in the day-to-day management of a working life;
4. Skill in applying theoretical knowledge to practical situations.

Syllabus:
Depending on the organisation’s structure and areas of involvement, students should cover most if not all of the following: practical aspects of planned and emergency maintenance, design, modification and installation, workshop processes, plant operation, testing and experimentation, power generation, electrical installation and maintenance, stock control, budgeting and financial control.

Assessment:
Diaries and reports as prescribed by the Department. Students are required to submit diaries
and reports at the end of each training period.

**ME432 AUTOMATIC CONTROL**

**Common Credit:** 14  
**Hours per week:** 3  
**Prerequisite:** ME 363

**Learning Outcomes:**  
To introduce students to the basic concepts of automatic control, in particular to industrial pneumatic and hydraulic control systems, and the methods of analysis of both open-loop and closed-loop control systems. On completion of the subject, students should be able to:  
1. Gain insight into the principle of automatic control;  
2. Design pneumatic control circuits for industrial processes;  
3. Design hydraulic control circuits for industrial processes;  
4. Analyze control systems.

**Syllabus:**  
Introduction to automatic control systems, application of fluid power systems, pneumatic components for pressures, flow and directional control; basic circuits, pneumatic symbols, pneumatic logic circuits; basic principles of hydraulic pumps, motors, actuators, valves, hydraulic circuits design; maintenance of hydraulic systems, micro-processor control in fluid power. Analysis of control systems: mathematical representation of control components and systems, characteristic functions, the root-locus method. Introduction to application of MATLAB and SIMULINK to control systems.

**Textbook:**  

**Reference:**  


**Assessment:**  
Continuous Assessment - 60%  
Written Examination - 40% (1 x 2 hours)

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**ME433 ADVANCED MANUFACTURING**

**Common Credit:** 14  
**Hours per week:** 3  
**Prerequisite:** ME 232

**Learning Outcomes:**  
To develop an understanding of advanced topics in manufacturing technology. On completion of the subject, students should understand:  
1. Processing of plastics;  
2. Surface technology;  
3. Quality assurance;  
4. CNC programming;  
5. Manufacturing in a competitive environment.

**Syllabus:**  

**Textbook:**  

**Assessment:**  
Continuous Assessment - 60%  
Written Examination - 40% (1 x 2 hours)

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**ME436 FLEXIBLE MANUFACTURING SYSTEMS**

**Common Credit:** 14  
**Hours per week:** 3

**Learning Outcomes:**  
To introduce students to FMS concepts and its applications. On completion of this subject, students should:  
1. Have a through understanding of the FMS concepts;
2. Have a reasonable understanding of FMS applications in industry;
3. Be able to use FMS-related computer software.

**Syllabus:**

**Textbook:**
To be specified. Departmental course notes

**Reference:**

**Assessment:**
Continuous Assessment - 100%

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**ME438 COMPUTER-INTEGRATED MANUFACTURE**

**Common Credit:** 14  
**Hours per week:** 3  

**Learning Outcomes:**
To introduce students to CIM concepts and their applications. On completion of the subject, students should:
1. Have a through understanding of the CIM concepts;
2. Have a reasonable understanding of CIM applications in industry;
3. Be able to use CIM related computer software.
4. Be able to perform CNC programming.

**Syllabus:**
Introduction to CIM concept, Manufacturing Systems, CAD: Fundamentals of CAD, Hardware in CAD design, Computer graphics software and database, CAM: CNC programming, Robot technology, Group technology, Computer-aided process planning and rapid prototyping.

**Textbook:**
To be specified. Departmental course notes

**Reference:**

**Assessment:**
Continuous Assessment - 100%

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**ME441 PROJECT I**

**Common Credit:** 5  
**Hours per week:** 3  

**Learning Outcomes:**
To provide the students with skills involved in handling a typical engineering project. On completion of the subject, students should be able to:
1. Identify the main activities of a typical engineering project;
2. Plan a detailed schedule of activities to complete and meet the project deadline.

**Syllabus:**
According to the nature of the project, this may include a combination of the following areas: literature survey, data collection, engineering analysis, design, manufacturing, computing and/or managerial techniques.

**Assessment:**
Continuous Assessment - 50%  
Preliminary written report - 50%

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**ME442 PROJECT II**

**Common Credit:** 5  
**Hours per week:** 3  

**Prerequisite:** ME 441  

**Learning Outcomes:**
To provide the students with the skills involved in handling a typical engineering project.
On completion of the subject, students should be able to:
1. Apply the engineering principles learnt in other subjects in the development of the project work;
2. Meet the requirements as set out in the project description.

**Syllabus:**
According to the nature of the project, this may include a combination of the following areas: data collection, engineering analysis, design, manufacturing, computing and/or managerial techniques. Submission of written project report.

**Assessment:**
- Continuous Assessment: 50%
- Final written report: 50%

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**ME451 APPLIED FLUID MECHANICS I**

**Common Credit:** 14
**Hours per week:** 3
**Prerequisite:** ME252

**Learning Outcomes:**
To enable students to apply the theory of fluid mechanics to a wide variety of fluid flows encountered in mechanical systems for the purpose of analysis, testing or design. On completion of the subject, students should have developed a good understanding in the following areas:
1. Fundamental principles of fluid mechanics,
2. Calculation of useful parameters such as velocities, pressures, forces, and energy losses associated with common fluid flows.

**Syllabus:**

**Textbook:**

**Reference Book:**

**Assessment:**
- Continuous assessment: 60%
- Written examination: 40% (1 x 2 hours)

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**ME452 APPLIED FLUID MECHANICS II**

**Common Credit:** 14
**Hours per week:** 3
**Prerequisite:** ME 451

**Learning Outcomes:**
To enable students to apply the theory of fluid mechanics to a wide variety of fluid flows encountered in mechanical systems for the purpose of analysis, testing or design. On completion of the subject, students should have developed a good understanding in the following areas:
1. Basic calculations in aerodynamics;
2. Basic calculations in turbo machinery for energy generation, pumping and compression;
3. Basic concepts of compressible and unsteady flows.

**Syllabus:**
Simple irrotational flow patterns, Superposition of simple flow patterns, Lift and drag, Circulation, Bound vortex, Kutta Joukowski Theorem, Wake and boundary layer Separation, Aerofoil characteristics, lift Coefficient and its variation with the incidence, finite wing, elliptical lift distribution. Fluid machinery including water turbines, Pumps and their selection criteria, Fans and compressors. Theory of rotodynamic machines and performance characteristics. Introduction to compressible and unsteady flows, Nozzle flow, Critical conditions, Normal shock, Oblique shock.

**Textbook:**

**Reference:**

**Assessment:**
- Continuous Assessment: 60%
- Written Examinations: 40% (1 x 2 hours)
ME 463 Vibration Analysis (R)

Prerequisites: ME 262(R), ME 434(N)

Contact Hours: 3 lecture hours/week for 15 weeks

PNG Credit: 14

Credit (accred.): 3

Learning Outcomes

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

Knowledge

LO1: Analyse the dynamic behaviour (vibrations) of mechanical systems having a single-degree of freedom

LO2: Analyse simple problems arising from the unbalanced masses in the rotating parts of machinery

LO3: Analyse the dynamic behaviour of systems having two or more degrees of freedom without damping the external forcing functions

LO4: Understand nature of vibration problems in machines, causes and practical remedies

Skills

LO5: Use MATLAB to simulate vibrating systems and normal mode calculations

LO6: Perform modal analysis using CAD software

Attitudes/Values

LO7: Be a lifelong learner through self-studies

Syllabus

This subject deals with the application of Newtonian and Energy methods for modelling vibrating systems with single and multiple degree freedom, principle of vibration transmission, vibration isolation and control, and vibration measurement. A brief discussion of machine vibration causes and remedies are included. Introduction to mechanical vibrations, lab. demonstration of vibrating systems, definitions, harmonic motion, vector and complex representations of harmonic motion, periodic motion, Fourier series, vibration terminology (3). Single degree of freedom system: modelling of systems, undamped free vibration, equation of motion (Newton’s law), equivalent stiffness, energy methods(6), Rayleigh method, viscously damped free vibration, logarithmic decrement, coulomb damping, structural — damping (6). Harmonic excitation of single degree of freedom system, rotating unbalance, rotor unbalance, whirling of shafts, support motion, vibration measuring instruments, (6) demonstration of instruments. Transient vibration from nonharmonic excitations (3). Two-degree of freedom system, normal mode vibration, coordinate coupling, forced harmonic vibration, vibration absorber, vibration damper(6), multi-degree of freedom systems, modal analysis(6); numerical methods. Vibration of continuous systems (6). Classical methods (3).

Textbook


References

- S.S. Rao, Mechanical Vibrations, Addison Wesley, 2nd ed.
- L. Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1975

Assessments

Continuous assessment: 60%
Final Written Exam: 40%

ME471 MECHANICAL SYSTEMS DESIGN

Common Credit: 14

Hours per week: 3

Prerequisite: ME372

Learning Outcomes:

To introduce students to system design procedures. On completion of the subject, students should:
1. Have a thorough understanding of the design procedures for mechanical systems;
2. Be able to design mechanical systems.

Syllabus:

Introduction to mechanical design process; planning for design process; customer satisfaction,
determination of customer requirements, use of QFD; concept generation methods, concept evaluation techniques; product design phase, form design, properties of common materials; product evaluation for performance, robust design, parameter and tolerance design for quality, robust design through testing; product evaluation for cost, manufacture, assembly, reliability, and environment; examples of mechanical systems.

Textbook:

Assessment:
Continuous Assessment - 60%
Written Examination - 40% (1 x 2 hours)

ME472 DESIGN FOR MANUFACTURE

Common Credit: 14
Hours per week: 3
Prerequisite: ME372

ME474 DESIGN AND ANALYSIS OF MECHANISMS

Common Credit: 14
Hours per week: 3
Prerequisite: ME 362

Learning Outcomes:
To introduce students to creativity and idea in mechanisms, and typical methods of analysis and synthesis of selected linkages. On completion of the subject, students should be able to:
1. Understand the actions and principles of operation of various types of mechanisms used in Mechanical engineering;
2. Carry out kinematic analysis.

Textbook:
To be specified.

syllabus:
Introduction to mechanisms for various action such as snap-action, linear and rotary actuation, fine adjustment, clamping, locating, escapements, indexing, oscillating, reciprocating, reversing, coupling, stop-pause-hesitation, transportation, loading and unloading, path and function generation, computing, speed changing and robotic. Basic linkage concepts, mobility criterion, synthesis of mechanisms, kinematic analysis of a four-bar linkage, velocity, acceleration, and inertia force in linkages.

Textbooks:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME476 COMPUTER-AIDED DESIGN

Common Credit: 14
Hours per week: 3
Prerequisites: ME 334, ME 272

Learning Outcomes:
On completion of the subject, students should be able to:
1. Effectively use Computer-Aided-Design software;
2. Produce two- and three-dimensional engineering drawing;
3. Understand Database interfaces for CAM.

Syllabus:
Use of CAD techniques within an integrated approach to conceptual design and links to manufacturing and assembly systems. Overview of standard CAD software packages. Drawing tools, Producing and viewing 2D drawings. Principles of geometric modelling: solid modelling, surface modelling, 2D modelling. Databases as the interface with computer aided manufacturing and production control.

Textbook:
To be specified.
ME 481 - FUNDAMENTALS OF NON-DESTRUCTIVE EVALUATION

Common Credit: 14
Hours per week: 3
Prerequisite: Nil

Learning Outcomes:
The objective of this subject is to equip the students with the basic techniques of non-destructive testing and to explain its application and usefulness in the industrial environment. On completion of the subject, the students should be able to acquire the knowledge of fundamentals of:
1. The theory and practice of various Non-destructive testing techniques.
2. The advantages and limitations of each technique and how they are applied in various industrial applications and their uses in quality control.

Syllabus:
Introduction to principles of various nondestructive testing techniques, the uses and benefits of various non-destructive testing techniques; Visual techniques, Liquid penetrant inspection, Magnetic particle inspection, Eddy current, Ultrasonic, Radiography, and other non-destructive testing techniques (optical probes, neutron radiography, laser-induced ultrasonics, time of flight diffraction, acoustic emission, crack depth gauges, thermography and texture analysis), NDT and design.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

ME 482 - FAILURE ANALYSIS

Common Credit: 14
Hours per week: 3
Prerequisites: ME 281, ME 381, ME 372

Learning Outcomes:
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. On completion of the subject, students should be able to:
1. Understand and appreciate what failure analysis means in terms of profitability and liability, and to be familiar with general procedures, techniques, and precautions in failure analysis;
2. Identify design-related failures and to analyze 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, and discuss how stress systems relate to fracture of ductile and brittle materials;
4. Appreciate and determine typical fatigue characteristics and the basic fracture modes and their characteristics, including the factors affecting ductile-brittle relationships, with a good grasp of the many interrelated factors involved in examining a fracture.

Syllabus:
Failure, failure analysis, failure analysis methodology, Tools and techniques of failure analysis, fracture mechanics, failure data retrieval through failure experience matrix, and reliability. Defects: types and characteristics; defects in casting, primary processing defects, secondary processing defects, effects of defects on service properties. Procedural steps for investigation; feedback system, investigation procedure, background information, visual examination, non-destructive testing,

**Textbook:**

**Reference:**

**Assessment:**
Continuous Assessment - 60%
Final Examination - 40% (1 x 2 hours)

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**ME 491 APPLIED THERMODYNAMICS**

**Common Credit:** 14
**Hours per week:** 3
**Prerequisite:** ME 391

**Learning Outcomes:**
To introduce students to more advanced topics in Thermodynamics. On completion of the subject, students should be able to:
1. Discuss layout of thermal power plant;
2. Discuss various approaches for improving efficiency of the power cycle;
3. Discuss fuel systems and alternative fuels.

**Syllabus:**

**Textbooks:**

**References:**

**Assessment:**
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

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**ME492 REFRIGERATION & AIR-CONDITIONING**

**Common Credit:** 14
**Hours per week:** 3
**Prerequisite:** ME 391

**Learning Outcomes:**
On completion of this subject, the students should be able to:
1. Estimate heat load for refrigeration and air-conditioning purposes;
2. Explain the function of refrigeration and air-conditioning materials and equipment.

**Syllabus:**
evaporators. Charging and testing of refrigeration systems. Basic systems control.

**Textbook:**
To be specified.

**Reference:**

**Assessment:**
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

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**ME494 AUTOMOTIVE ENGINEERING**

**Common Credit:** 14
**Hours per week:** 3

**Learning Outcomes:**
To introduce students to the structure, function, and general design and maintenance aspects of the engineering systems of an automobile. On completion of the subject, students should be able to:
1. Describe the major engineering systems;
2. Apply principles of relevant fields of study in basic design considerations of the systems;
3. Effect minor modifications to the design of some systems;
4. Appreciate the importance of improving thermal efficiency and reducing pollution of the environment.

**Syllabus:**

**Textbooks:**

**References:**

**Assessment:**
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

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**ME496 RENEWABLE ENERGY**

**Common Credit:** 14
**Hours per week:** 3
**Prerequisite:** ME 391

**Learning Outcomes:**
On completion of the subject, students should be able to:
1. Discuss different types of renewable energy sources;
2. Discuss the technologies for renewable energy utilization and conversion devices currently available;
3. Explain the economics of renewable energy conversion devices.

**Syllabus:**
Range of renewable energy resources and its potential. Selected technologies, which are generally recognized as being the most feasible technically and economically, e.g., solar (both thermal and photo-voltaic), wind, hydro, tidal, waste and biomass.
Methods of harnessing and using energy from these sources, including hybrid systems. Limitation of renewable energy harnessing: principles of energy conversion, storage and transfer for renewable energy systems.
Feasibility and design studies for selected renewable energy technologies. National and international trends.

**Textbook:**
To be specified.
Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

MASTER OF SCIENCE (MSc) IN MECHANICAL ENGINEERING

1.0 OUTLINE OF PROGRAMME

1.1 Introduction
This department shares the view with others that there is a need to develop postgraduate training facilities in mechanical engineering to meet the manpower requirements of industries, government departments and academic institutions. This postgraduate course, that combines both formal lectures and self-motivated research, aims to meet the present need. In order to facilitate greater participation of practising engineers in industries and government departments, the course has been structured to have built-in inflexibility.

1.2 Flexible Instructional Features
In order to facilitate greater participation of potential students, intensive instructions are given over a period of three to four weeks per semester. After each period, candidates return to their normal place of employment to study on their own and complete prescribed assignments. Teaching periods will preferably be in the three to four weeks prior to the commencement of each semester of the academic year. A maximum of two subjects can be taken in each semester. The flexibility built into the programme has employers in mind, who might otherwise be unwilling to release their employees for studies over a prolonged period.

1.3 Course Duration
There is no course duration set for the course, but students are normally expected to complete the course in less than three years, i.e., four to six semesters.

1.4 Entry Requirements
Candidates with a bachelor's degree or equivalent in engineering will be admitted for enrolment; priority will be given to candidates with past superior academic performance or to those who have gained adequate professional experience. Some applicants may be required to take a prescribed number of undergraduate subjects to qualify for candidacy.

2.0 COURSE STRUCTURE
The course structure has three major components as specified below:

2.1 Core Subjects
Four subjects come under this category out of which at least two subjects including Research Methodology & Computation should be taken. Each course carries 3 credits.

2.2 Dissertation
Each student is required to engage in a research project and write a dissertation for which 6 credits will be earned. Topics for the project will preferably be chosen to aid in the solution of specific industrial problems in consultation with the student's academic supervisor.

2.3 Elective Subjects
Elective subjects contain topics dealing with current advances in technology which are grouped together under three subject areas. A minimum of four subjects should be taken from groups A, B, and C. Each subject will be covered in 35-42 lecture hours. Candidates will earn 3 credits upon successful completion of each subject.

2.4 Degree Requirements
In order to complete the degree requirements, each student is expected to earn 24 credits (six subjects plus a dissertation).

2.5 Course Examinations
Course examinations will take place when the students return to the University for subsequent instruction periods. The award of the Degree of Master of Technology will be made in accordance with the Rules of the University's Higher Degrees Committee.
3.0 SUBJECT TITLES

1. CORE SUBJECTS
   MM 001  Advanced Engineering Mathematics I
   MM 002  Advanced Engineering Mathematics II
   MM 003  Numerical Methods
   MM 004  Research Methodology & Computation

2. DISSERTATION
   MM 090  Research Project

3. ELECTIVE SUBJECTS
   GROUP A
   MM 006  Advanced Machine Design
   MM 007  Materials Handling Systems
   MM 008  Computer-Aided Design
   MM 009  Finite Element Method
   MM 010  Advanced Vibration
   MM 011  Noise Control Engineering

   GROUP B
   MM 012  Computer-Integrated Manufacturing
   MM 013  Conventional Manufacturing
   MM 014  Robotics in Manufacturing
   MM 015  Total Quality Management
   MM 016  Just-In-Time Systems
   MM 017  Advanced Quality Control
   MM 018  Planned Preventive Maintenance

   GROUP C
   MM 019  Internal Combustion Engines
   MM 020  Gas Turbines
   MM 021  Hydraulic Machines
   MM 022  Advanced Heat Transfer
   MM 023  Renewable Energy
   MM 024  Fossil Fuels & Combustion Technology
   MM 025  Refrigeration & Air-Conditioning

4.0 SUBJECT DETAILS

MM001  ADVANCED ENGINEERING MATHEMATICS I

Credits:  3
Hours per week:  15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Use Fourier Series and Laplace Transform for solving problems;
2. Solve common types of partial differential equations encountered in engineering problems;
3. Apply vector analysis theorems for solving engineering problems.

Syllabus:

Textbook:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM002  ADVANCED ENGINEERING MATHEMATICS II

Credits:  3
Hours per week:  15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Solve linear first order set of ordinary differential equations;
2. Apply theory of analytical functions and commonly used series for solving engineering problems.

Syllabus:
Ordinary Differential Equations: Simultaneous linear differential equations, complementary functions and particular integrals for systems of
Department of Mechanical Engineering


Textbook:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM 003 NUMERICAL METHODS

Credits: 3
Hours per week: 15 (A minimum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Find roots of equations and polynomial equations of higher order;
2. Solve linear and non-linear differential equations;
3. Find eigen values, approximation of functions and their integration;

Syllabus:

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM004 RESEARCH METHODOLOGY AND COMPUTER APPLICATIONS

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Apply research methodology;
2. Use the computer applications for use in independent study and research.

Syllabus:

**Textbook:**

**Assessment:**
- Continuous assessment - 60%
- Written Examination - 40% (1 x 2 hours)

**MM 005 RESEARCH PROJECT**

**Credits:** 6 (A total of 270 hours)

**Objective:**
On completion of the subject, the student should be able to:
1. Identify the main activities of a typical engineering product, process or system;
2. Plan a detailed schedule of activities to complete and meet the project deadline;
3. Apply the engineering principles learnt in other subjects in the development of the project work;
4. Write a dissertation on the project work.

**Syllabus:**
This course involves a project given to each student as an independent study for which lecturers will provide guidance. Topics of research project will be chosen in consultation with supervisors in areas relevant to PNG conditions. Candidates are expected to prepare objectives of the project, review the literature, propose the methodology of research, and initiate and conduct the research work required. The candidate is expected to present results of the research in the form of a dissertation.

**Assessment:**
- Continuous assessment and submission of a dissertation - 100%

**MM006 ADVANCED MACHINE DESIGN**

**Credits:** 3

**Hours per week:** 15 (A maximum of 45 hours)

**Objective:**
On completion of the subject, the student should be able to:
1. Apply the fundamentals of product planning and development;
2. Carry out systematic design of industrial projects.

**Syllabus:**
The scope of design: fundamentals of engineering systems and systematic approach; the design process; product planning; product specification; conceptual design; search for solutions; methods of analysis; choosing the best design; product design; reliability; design project (preferably from industry).

**Textbooks:**
Departmental course notes

**Assessment:**
- Continuous Assessment - 60%
- Written examination - 40% (1 x 2 hours)

**MM007 MATERIALS HANDLING SYSTEMS**

**Credits:** 3

**Hours per week:** 15 (A maximum of 45 hours)

**Objective:**
On completion of the subject, the student should be able to:
1. Analyze and design integrated material handling systems for automatic storage and retrieval of unit loads;
2. Specify key parameters for such systems.

**Syllabus:**
Analysis and design of integrated material handling systems; automatic storage and retrieval of unit loads, and identifying and establishing boundary conditions on key parameters required to specify the desired system required for equipment vendors to design appropriate hardware.
Department of Mechanical Engineering

Textbook:
Departmental course notes

Assessment:
Continuous assessment  -  60%
Written Examination  -  40%  (1 x 2 hours)

MM008 COMPUTER-AIDED DESIGN

Credits:  3
Hours per week:  15  (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Understand the supporting technologies for CAD;
2. Introduce practical applications of CAD relevant to manufacturing engineering.

Syllabus:
History and advantages of CAD; classification of CAD systems; system hardware and software packages; conceptual design of CAD systems; artificial intelligence and knowledge databases in CAD; interfaces of a CAD system with its application environment; geometric modelling- wire-frame modelling, surface modelling, solid modelling; fundamentals of Finite Element Method - a CAD tool; CAD application examples.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment  -  60%
Written Examination  -  40%  (1 x 2 hours)

MM009 FINITE ELEMENT METHOD

Credits:  3
Hours per week:  15  (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to apply the Finite Element Method for solving mathematical problems related to practical engineering situations.

Syllabus:
General description of the Finite Element Method (FEM); static and dynamic analysis of mechanical engineering problems; solution of finite element equations; general procedure of finite element method; finite element meshes; review of finite element packages; comparison of FEM with other methods of analysis.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment  -  60%
Written Examination  -  40%  (1 x 2 hours)

MM010 ADVANCED VIBRATION

Credits:  3
Hours per week:  15  (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to analyse mechanical vibration in any one of the areas of random vibrations, nonlinear vibrations and vibrations of continuous systems.

Syllabus:
This course may be offered in any of the following topics depending on the requirements of attending students:
(a) Mechanical Vibrations and Experimental Methods in Vibrations: Linear theory of Vibrations of finite number of degrees of freedom systems via languages equations Sensors, instruments, measurements techniques data acquisition methods; data reduction methods for vibration measurement and modal analysis; applications including turbo machinery blades, vanes, gears, bearings and rotors;
structures such as beams, frames and machine foundations.

(b) Continuous systems: Introduction to continuous systems; vibration of strains, longitudinal vibration of rods, torsional vibration of rods; beam vibration, effect of rotary inertia and shear defunction; vibration of the plates.

(c) Random vibrations: Random phenomena, defining expected value, frequency responses function, probability distribution, correlation of signals, power spectrum, power spectral density, Fourier Transform, response of single and multidegree systems to stationary random excitations.

(d) Nonlinear vibrations: Introduction to nonlinear vibration, exact methods of solution, approximates analytical methods, graphical methods, stability of equilibrium, numerical methods.

Vibration measurement and control common to all topics.

Textbooks:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

**MM011 NOISE CONTROL ENGINEERING**

Credits: 3

Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Apply basic concepts of the nature of sound and noise to engineering situations;
2. Measure and analyse noise signals;
3. Recommend noise control measures in machinery and processes.

Syllabus:
The nature of sound; units; sound measurements; instruments; effects of noise on people; hearing loss; noise and law; near and far field noise; acoustics of rooms and enclosures, noise analysis; noise criteria; damping of panels; principles of noise control: vibration isolation, noise source identification and their relative importance, noise control procedures applicable to source, path and receiver; case studies: cooling fan, mine ventilation fan noise, duct noise, material handling impact noise, engine noise, turbine noise, jet noise; factory noise, industrial noise control programme.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

**MM012 COMPUTER-INTEGRATED MANUFACTURING**

Credits: 3

Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Understand the concepts of Computer-Integrated Manufacturing;
2. Recognize constituent parts of CIM systems, and integration of the parts to form a system

Syllabus:
Requirements for implementing CAD/CAM systems; components design using geometric modelling techniques; classification systems for part-family formation; computer numerical control; computer-aided quality control; robotics; automated guided vehicles; computer-aided process planning; concepts and applications of flexible manufacturing systems (FMS); computer-aided manufacturing management.
Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM013 CONVENTIONAL MANUFACTURING TECHNOLOGY

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to understand relevant fundamentals and real-world practices of some advanced manufacturing processes, and interrelationships among many technical and economic factors involved.

Syllabus:
Powder metallurgy; forming and shaping plastics and composite materials; non-traditional machining processes - chemical machining, electrochemical machining, electrochemical grinding, electrical-discharge machining, travelling-wire electrical-discharge machining, laser-beam machining, electron-beam machining, hydrodynamic machining; economics of non-traditional machining processes; joining processes and equipment - oxyfuel gas welding, arc-welding processes, consumable and nonconsumable electrodes, resistance welding processes; surface technology; competitive aspects and economics of manufacturing - selection and substitution of materials, selection of manufacturing processes, manufacturing costs and value engineering.

Textbook:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM014 ROBOTICS IN MANUFACTURING

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to understand industrial robots, their mechanical elements, sensory systems, and control systems, and their use in manufacturing.

Syllabus:
History and development of robotics; types and configurations of robot; mechanical elements of robot - arms, hands, actuation methods; robot senses and sensory systems - vision, touch, hearing; programming and controlling the robots the use of robots in computer-aided manufacture; artificial intelligence for robots.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM015 TOTAL QUALITY MANAGEMENT (TQM)

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Understand the fundamental concepts of TQM;
2. Understand the procedure for implementation of TQM in industries.
Syllabus:
Introduction; TQM defined; CWQM in Japan; management tools: histogram, cause and effect diagram, check sheets, pareto diagram, control charts, scatter diagram, binomial probability paper: customer-supplier relationship; continuous improvement models; tools for continuous improvement; management commitment; implementation strategies: quality control circles, training of workforce, importance of communication, improvement of interpersonal relationship; case studies.

Textbooks
To be specified.

Reference:
Total Quality Management (The Plastics and Rubber Institute, UK)

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM016 JUST-IN-TIME SYSTEM

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Understand the basic philosophies of JIT system;
2. Gain sufficient understanding for implementation of JIT in a manufacturing industry.

Syllabus:
Brief history of Just-In-Time system; definition, objectives and benefits of JIT; basic philosophies; key elements of JIT; Kanban; Kanban rules; inventory control under JIT; reduction of lead time, reduction of set-up time, standard operations; machine layout in JIT, multifunctional workforce, job rotation, training requirements; improvement activities; autonomous defects control; functional management and its organization; adapting to JIT system, obstacles; future development of JIT system.

Textbook:
To be specified.

Reference:
Monden, Y., Toyota Production System, Institute of Industrial Engineers, 1983

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM017 ADVANCED QUALITY CONTROL

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Prerequisite: Knowledge of statistics.

Objective:
On completion of the subject, the student should be able to:
1. Understand both classical and advanced acceptance sampling methods;
2. Gain in depth understanding of statistical process control methods.

Syllabus:
Advanced methods applied to quality control. Acceptance sampling plans from the classical lot attribute plan to sophisticated multi-lot dependent plans. Classical treatments and recent developments in process control. Evaluation, design and maintenance of quality control programs.

Textbook:
Departmental course notes

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM018 PLANNED PREVENTIVE MAINTENANCE
Department of Mechanical Engineering

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Understand the fundamentals of preventive maintenance;
2. Implement and supervise maintenance programmes.

Syllabus:
Maintenance fundamentals; systematic approach to maintenance; maintenance economics; maintenance organization; origin of maintenance problems; inspection and maintenance tools; inspection and lubrication schedules; condition based maintenance; maintenance records; maintenance inventory examples of maintenance of elements and machines; maintenance planning; scheduling; manual vs computer assisted maintenance; motivation of workforce; implementation of maintenance programme.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM019 INTERNAL COMBUSTION ENGINES

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Understand advanced concepts of the combustion process;
2. Perform calculations for the design of engines and selection of equipment.

Syllabus:
Types and arrangements; theoretical gas cycles; combustion thermodynamics; actual gas cycles - dynamometers, fuel and air flow, exhaust gas analysis; air, fuel, and exhaust flows - pumping and scavenging work, carburetion, fuel injection, measurement techniques; combustion and emissions - auto ignition, nitrogen oxides, carbon monoxide, hydrocarbons, particulates, emission control and legal requirements; fuel technology - gasoline, diesel fuel, fuel additives; engine performance - criteria, testing, critical factors.

Textbook:

Assessment:
Continuous assessment - 60%
Written Examination - 40% (1 x 2 hours)

MM020 GAS TURBINES

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Estimate performance parameters for different types of gas turbines, and gas turbine arrangements;
2. Gain a thorough knowledge of the principles of the operation of industrial gas turbines;
3. Apply the principles of the operation of modern gas turbines, parts and components.

Syllabus:
Department of Mechanical Engineering

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**MM021 HYDRAULIC MACHINES**

**Credits:** 3  
**Hours per week:** 15 (A maximum of 45 hours)

**Objective:**  
On completion of the subject, the student should be able to:  
1. Analyse fluid flow in hydraulic machines;  
2. Design rotodynamic machinery and their components;  
3. Select pumps and turbines for industrial applications.

**Syllabus:**  
System analysis for pump selection, specific speed and modelling laws, specific speed charts; design considerations for various applications; impeller design - impeller layout, development of impeller vane; volute design, double and triple volute casing design, circular volute; design of multi-stage casing; double-suction pumps and side-suction design; pump applications - vertical pumps, wet-pit pumps, barrel-mounted pumps, slurry pumps, pumps for chemical processes; hydraulic turbines - selection process, turbine performance prediction, fixed guide vane turbines, variable guide vane turbines; pump and turbine components - mechanical seals, bearings and lubrication; gear pumps and vane pumps; compressors - types and design considerations; vibration and noise - causes of vibration, cavitation, diagnosis of pump vibration problems; controls - constant power control, constant pressure control, constant flow control.

**Textbook:**  
To be specified.

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**Reference:**  

**Assessment:**  
Continuous assessment - 60%  
Written Examination - 40% (1 x 2 hours)

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**MM022 ADVANCED HEAT TRANSFER**

**Credits:** 3  
**Hours per week:** 15 (A maximum of 45 hours)

**Objective:**  
On completion of the subject, the student should be able to:  
1. Analyse complex heat transfer problems;  
2. Perform calculations for design/operation changes and for equipment selection.

**Syllabus:**  
Steady-state heat conduction in one, two, and three dimensions - graphical and numerical methods; unsteady-state heat conduction - chart and numerical methods; convection - review, dimensional analysis, boundary layer analysis, Reynolds' analogy, free convection, forced convection inside tubes and over exterior surfaces; heat exchangers - types and arrangements, LMTD and effectiveness methods of analysis, fouling factors, selection; radiation - review, gas-filled enclosures, combined modes with conduction and convection; boiling heat transfer, condensing heat transfer.

**Textbook:**  

**Assessment:**  
Continuous assessment - 60%  
Written Examination - 40% (1 x 2 hours)

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**MM023 RENEWABLE ENERGY**

**Credits:** 3  
**Hours per week:** 15 (A maximum of 45 hours)
Objective:
On completion of the subject, the student should be able to:
1. Discuss different types of renewable energy sources;
2. Discuss the technologies for renewable energy utilization and conversion devices currently available;
3. Explain the economics of renewable energy conversion devices.

Syllabus:
Range of renewable energy resources and its potential; selected technologies generally recognized as being the most feasible technically and economically, e.g., solar (both thermal and photo-voltaic), wind, hydro, tidal, waste and bio-mass; methods of harnessing and using energy from these sources, including hybrid systems; limitations of renewable energy harnessing; principles of energy conversion; storage and transfer for renewable energy systems; feasibility and design studies for selected renewable energy technologies; national and international trends.

Textbook:
To be specified.

Reference:

Assessment:
Continuous assessment - 60%
Written examination - 40% (1 x 2 hours)

MM025 REFRIGERATION AND AIR-CONDITIONING

Credits: 3
Hours per week: 15 (A maximum of 45 hours)

Objective:
On completion of the subject, the student should be able to:
1. Estimate heat load for air-conditioning and refrigeration purposes;
2. Describe air-conditioning and refrigeration materials and equipment.

Syllabus:
Air cycle; body comfort; psychrometric chart and processes; principles of heat load estimation for air-conditioning systems; types of air-conditioning equipment; air distribution; ducts; residential and commercial air-conditioning; air-conditioning...
equipment; refrigerants; types of refrigeration systems; food, and growth of micro-organisms; basic principles of heat transfer; latent heat; calculation of heat load; insulation; evaporator; condenser design; compressors; charging and testing of refrigeration systems; basic refrigeration controls; electrical components.

**Textbook:**
To be specified.

**Reference:**

**Assessment:**
Continuous assessment  -  60%
Written Examination  -  40% (1 x 2 hours)