FREDERICK UNIVERSITY

**School of Engineering and Applied Sciences**
**Department of Mechanical Engineering**

# COURSE OUTLINE

| | | |
|---|---|---|
| Programme of Studies: | ***BSc in Mechanical Engineering*** | |
| Name of the module: | ***AMEW 101 - Mechanical Workshop*** | |
| Target group: | ***Mechanical Engineering students (Required)*** | |
| Level of the unit: | ***BSc – 1$^{ST}$Semester*** | ***Introductory*** |
| Entrance requirements: | ***None*** | |
| Number of ECTS credits: | ***2 (Average student working time: 50 hours)*** | |
| Lecturer: | ***Athanasiou Charalambos*** | |
| Office: | ***Library Building, Office 212*** | |
| Email | ***eng.ca@fit.ac.cy*** | |
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| Office hours: | ***See above webpage for details*** | |

| **Competences to be developed:** | |
|---|---|
| 1 | Understand the importance of measurements in engineering design and dimensional tolerances in manufacturing<br>Describe the workshop machinery and be aware of their usage and capabilities. |
| 2 | Use correctly measuring tools for linear, angular, form and surface quality measurements and apply safe working practice at all times in workshop and laboratory environments |
| 3 | Compare the precision, range and error of same type measuring instruments and select the appropriate depending on the application needs. |
| 4 | Evaluate the appropriate tolerances for different types of fit between mating parts. |
| 5 | Produce simple mechanical parts on milling, turning, drilling and welding machines |

| **Estimated student's work time distribution in hours:** | | | |
|---|---|---|---|
| Contact hours | | Student's private time | |
| Lab Work | 30 | Private Study | 6 |
| Visit to modern workshops of local industry | 6 | Lab Report | 5 |
| Lab Assessment | 3 | | |
| Total: | **39** | Total: | **11** |

## Learning outcomes

**Students should be able to:**

**Lab Work:**

Understand all safety regulations applied for work in a mechanical workshop

Use safe working practice at all times in workshop.

Understand the role of measurements in engineering design and manufacturing

Describe the types and sources of errors in measurements

Use metric and imperial system of length measuring units

Use line graduated instruments: machinist's rule, vernier calliper, and micrometer.

Describe the accuracy of each instrument and select the appropriates depending on the quality needs.

Use instruments and apply methods for measuring angles (sine bar, sinus and tangent method, angle gauge blocks, bevel protractor, combination square)

Execute form measurements using the dial indicator

Apply the appropriate method for measuring perpendicularity, flatness, roundness, parallelism, eccentricity, etc.

Describe dimensional tolerances and define the notions of basic size, deviation and tolerance for a shaft and a hole according to ISO system.

Calculate the allowance, clearance, interference and limit dimensions for all types of fit.

Describe surface texture and properties (surface roughness, measurement, units. Symbols for surface roughness in DIN, ASA and BS, roughness parameters,

Use instruments for roughness measurements.

Describe the main features and controls of lathes, lathe structure and cutting tools

Define basic cutting parameters (cutting speed, depth of cut, feed rate)

Operate a lathe for cutting a representative work piece

Describe surface texture and properties (surface roughness, measurement, units. Symbols for surface roughness in DIN, ASA and BS, roughness parameters,

Use instruments for roughness measurements.

Describe the main features and controls of milling machines, machine's structure and cutting tools

Define basic cutting parameters (cutting speed, depth of cut, feed rate)

Operate a milling machine for cutting a representative work piece

Describe principles of welding and typical welding processes such as arc welding with coated electrodes, TIG, MIG, induction welding, resistance welding, and gas welding.

Visit to modern workshops of local industry

**Course Content (Syllabus):**

- Engineering measurements
  - Importance of measurements in engineering design and manufacturing. Types of errors in measurements / sources of errors, units in metric and imperial system, conversions between the two systems
  - Measurement of linear dimensions, Line graduated instruments: Machinist's rule, vernier caliper, micrometer (mechanic & digital), description, mode of use, accuracy, applications. Gauge blocks: Description, mode of use, accuracy, applications
  - Measurement of angular dimensions: Units, subdivisions, conversions, instruments and measuring methods (sine bar, sinus and tangent method, angle gauge blocks, bevel protractor, combination square)
  - Comparative length-measuring instruments – Dial indicator: Description, mode of use, accuracy, applications
  - Form measurement (perpendicularity, flatness, roundness, parallelism, eccentricity, etc). Definitions, symbols, instruments and measuring methods.
  - Dimensional tolerances: Basic size, deviation and tolerance for a shaft and a hole according to ISO system. Types of fit, features of dimensional relationships between mating parts (allowance, clearance, interference, limit dimensions etc)
  - Surface texture and properties: Surface roughness, measurement, units. Symbols for surface roughness in DIN, ASA and BS. Roughness parameters, instruments.
- Lathes and turning processes
  - Main features and controls of lathes.
  - Lathe structure (models, typical structural parts, power raw, most significant dimensions), Cutting tools (structural material, tool geometry, tool selection method, Cutting fluids)
  - Basic cutting parameters (cutting speed, depth of cut, feed rate)
  - Safety precautions
  - Performance on face turning and cylindrical surface turning
  - Performance on thread cutting, hole drilling, slot cutting and non symmetrical lathe cutting
  - Cutting forces experimental estimation for various cutting parameters
- Milling machines and milling operations
  - Main features and controls of milling machines. Horizontal and vertical milling machines.
  - Milling machine structure (models, typical structural parts, power raw, most significant

dimensions), Milling tool properties (structural material, tool geometry, tool models, tool selection method),
  - Basic milling parameters (cutting speed, depth of cut, feed rate)
  - Performance of slab or face milling and slot milling (up milling and down milling)
  - Gear cutting performance using a milling machine
- Operation and programming of CNC machine tool using manual programming, G/M codes.
- Welding
  - Principles of fusion welding (modes of metal transfer, heat flow, metalographic characteristics of welded joint)
  - Typical welding processes (arc welding with coated electrodes, TIG, MIG, induction welding, resistance welding, gas welding), Safety precautions.
  - Performance of arc welding using coated electrodes for various welding parameters (welding material properties and dimensions, coated electrode material and dimensions, welding current, welding polarity)
  - Performance of gas welding method using various welding parameters
  - Permanent stress and strain in welding structures

**Teaching Methodology:**

- Lectures to understand specific topics such as surface roughness, dimensional tolerances, form measurements, machining principles, cutting conditions, welding principles etc.
- Hands-on training on the equipment of a mechanical workshop (measurement instruments, cutting machines, welding machines, etc.)
- Visits to modern workshops of the local industry.

| Assessment Weights | Total |
|---|---|
| Lab test | 60% |
| Participation | |
| Lab reports | 40% |

**Note:** The assessment weights for the course work and the laboratory work is decided by the Department before the beginning of the semester. The details on the number of tests/homework assignments projects etc, as well as their assessment weights are decided by the academic staff responsible for the course.

**Bibliography:**

**Textbooks:**


- Fundamentals of Modern Manufacturing: Materials, Processes, and Systems by Mikell P. Groover, John Wiley & Sons, 3rd edition 2007


**References:**


- Manufacturing Processes for Engineering Materials, by Serope Kalpakjian, Steven R. Schmid, Prentice Hall, 2003.
- Theory and Design for Mechanical measurements, by R.S. Figliola D.E. Beasley, Willey publishers, 3rd ed. 2000.
- Machinery's Handbook, by Oberg Jones, Horton Ryffel, McCauley Heald and Hussain P. Smid, Industrial press, 27th ed., 2005
- Metal Cutting and High Speed Machining by D. Dudzinski (Editor), A. Molinari (Editor), H. Schulz (Editor), Plenum Pub Corp, 2002
- Applied Manufacturing Process Planning: With Emphasis on Metal Forming and Machining by Donald H. Nelson, George, Jr. Schneider, Prentice Hall, 1st edition, 2000.