UNIVERSITI TEKNIKAL MALAYSIA MELAKA	**TEACHING PLAN** **UNIVERSITI TEKNIKAL MALAYSIA MELAKA** **FAKULTI KEJURUTERAAN MEKANIKAL**

MECHANICAL ENGINEERING LABORATORY III		
BMCG3011	**SEMESTER 2**	**SESI 2022/2023**

1.0 OBJECTIVE

The objective of this course is to introduce students to engineering practice in the field of Thermodynamics, Fluid Mechanics and Solid Mechanics.

2.0 LEARNING OUTCOMES

At the end of this course, students should be able to:

LO1 Observe discipline in attending laboratory sessions, applied safety precautions before, during and after conducting experiments in terms of experimental procedures and aware of the general experimental ethics.
LO2 Plan, design and conduct experiments to prove a proposed hypothesis out of a given real and practical engineering problem.
LO3 Write a well organised, sensible and readable technical reports.

3.0 SYNOPSIS

Introduction to safety procedures in a laboratory. Hypothesis formulation. Design of experiments. Data analysis. Use of graphical presentation techniques for experimental data. Error and uncertainty. Measurement accuracy and precision. Statistical analysis. Good laboratory report writing.

The experiments will be conducted in mechanical engineering laboratories that study fundamental engineering concepts in:-

A) SOLID MECHANICS

i) Stress-strain Analysis of a Simple Beam
Synopsis
For a simple supported beam, it can be proved that the nominal or bending stress along the beam may be determined from the general formula of bending theory.
Objective

- to analyze the strain-stress behaviour of a simply supported beam through stress-strain measurement method by using strain gauges.

ii) Thin & Thick Cylinder Analysis

Synopsis

Stresses systems or distributions between thin and thick cylinders.

Objective

- to analyze, determine and compare the stresses systems for the thin and thick walled pressure vessels or cylinders.

iii) Curve & Davit Test

Synopsis

The load systems to the four test structures; quarter circle, semicircle, curved davit and angled davit structures.

Objective

- To apply strain energy concept to define the deformation of a structure in terms of its horizontal and vertical deflections for the four test structures; quarter circle, semicircle, curved davit and angled davit structures.

iv) Strut Buckling

Synopsis

Compressive loads always lead to exhibit elastic instabilities. One type of elastic instabilities is known as buckling. Buckling is a failure of structural abilities due to over maximum compressive load.

Objective

- To observe and determine the buckling behaviour and critical load for a pinned and a fixed end strut.

B) FLUID MECHANICS

i) Boundary Layers

Synopsis

Boundary layer, in fluid mechanics, thin layer of a flowing gas or liquid in contact with a surface such as that of an airplane wing or of the inside of a pipe. The fluid in the boundary layer is subjected to shearing forces. A range of velocities exists across the boundary layer from maximum to zero, provided the fluid is in contact with the surface. Boundary layers are thinner at the leading edge of an aircraft wing and thicker toward the trailing edge. The flow in such boundary layers is generally laminar at the leading or upstream portion and turbulent in the trailing or downstream portion.

Objective

- To investigate the characteristics of the velocity distribution in a boundary layer on smooth and rough surfaces of plates.

ii) Drag Measurement

Synopsis

As an object moves through a fluid it experiences forces from the interaction with the fluid. Forces in the direction of the object's motion are referred to as drag. Drag forces act against the object motion, and are in general dependent on the velocity. Depending on the flows conditions different phenomena could be responsible for drag creation.

Objective

- To determine the drag coefficient of a circular cylinder using direct weighing and pressure distribution methods.

iii) Laminar Flow Visualisation

<u>Synopsis</u>

The concept of a boundary layer and dealt with the effects viscosity has on a fluid adjacent to solid surface and with the calculation of forces acting on the surface due to fluid friction. The knowledge of potential flow and of boundary layer theory makes it possible to treat and external flow problem as consisting broadly of two distinct regimes that immediately adjacent to the body's surface, where viscosity is predominant and where frictional force is generated, and that outside the boundary layer, where viscosity is neglected but velocities and pressure are affected by the physical presence of the body together with its associated boundary layer.

<u>Objective</u>

- To investigate and analyse the flow pattern of different geometry body submerged in a fluid.

iv) System and Pump Characteristics

<u>Synopsis</u>

The most common machine for causing liquids to flow through piping systems is the centrifugal pump. The centrifugal pump is well suited to situations requiring moderate to high flowrates and modest increases in head (or pressure). Typical applications include municipal water supply systems, and circulating water heating and cooling system for buildings. For very high pressure, low flow applications, positive displacement pumps are more suitable. Positive displacement pumps move fluids with pistons, gears or vanes and flowrate is a function of rotational speed and has little if any dependence on the pressure rise. A common application of a positive displacement pump is that used to supply high pressure oil for hydraulic actuators such as those on a large earth moving machines.

<u>Objective</u>

- To determine the system and pump characteristic curves for a pump by establishing the operating point of the pump.

C) THERMODYNAMICS

i) Cooling and Dehumidification Process

<u>Synopsis</u>

Air Conditioning system is used as the control of the atmosphere so that a desired temperature, humidity, distribution and movement are achieved. Usually, cooling and dehumidification process is used in air conditioning system. Cooling is a heat removable process from close space to others in other to reduce and maintain the space temperature while dehumidification is a moisture removable process from the air without change in its dry bulb temperature.

<u>Objective</u>

- To illustrates the cooling and dehumidification process on Psychometric Chart.
- To learn about the planning of a measurement series, the reading of measurement results and the conversion of measurements into a statement of theoretical principle.

ii) Water Cooling Tower System

Synopsis

The evaporation process use by the cooling tower to lowering the temperature of the water that's being circulated throughout the system. The purpose of a cooling tower is to cool down water that gets heated up by industrial equipment and processes. Water comes in the cooling tower hot (from industrial process) and goes out of the cooling tower cold (back into the industrial process).

Objective

- To investigate the relationship between cooling load and cooling range.

iii) Linear Heat Conduction

Synopsis

Thermal conduction is the transfer of heat energy in a material due to the temperature gradient within it. It always takes place from a region of higher temperature to a region of lower temperature. A solid is chosen for the experiment of pure conduction because both liquids and gasses exhibit excessive convective heat transfer. For practical situation, heat conduction occurs in three dimensions, a complexity which often requires extensive computation to analyse. For experiment, a single dimensional approach is required to demonstrate the basic law that relates rate of heat flow to temperature gradient and area.

Objective

- To determine the thermal conductivity (k) of a metal specimen by using linear heat conduction.

iv) Radial Heat Conduction

Synopsis

Thermal conduction is the transfer of heat energy in a material due to the temperature gradient within it. It always takes place from a region of higher temperature to a region of lower temperature. A solid is chosen for the experiment of pure conduction because both liquids and gasses exhibit excessive convective heat transfer. For practical situation, heat conduction occurs in three dimensions, a complexity which often requires extensive computation to analyse. For experiment, a single dimensional approach is required to demonstrate the basic law that relates rate of heat flow to temperature gradient and area.

Objective

- To determine the thermal conductivity (k) of a brass specimen by using radial heat conduction.

4.0 REFERENCES

a. Wheeler, A.J. and Ganji, A.R., 2010. *Introduction to Engineering Experimentation*, 3rd Ed., International Edition Pearson.
b. Cengel, Y. A. and Boles, M. A..2007. *Thermodynamics: An Engineering Approach*, 6thEd., McGraw Hill.Singapore
c. Yuan, C.S., 2006, *Fluid Mechanics II*, Pearson Prentice Hall, Malaysia.
d. Hibbeler, R. C., 2007, *Solid Mechanics*, 7th Ed., Prentice Hall.
e. Varinder Taprial, Priya Kanwar. 2018, *Heating, Ventilation & Air-Conditioning*, 1st Edition, bookboon.com Ltd.

6.0 COURSE INSTRUCTIONS

Attendance is compulsory for all laboratory sessions including briefing and discussion sessions and should be more than 80% of the total contact hours.

7.0 SUBJECT ASSESSMENTS

No	Learning Outcome	Program Outcome	Assessment Method	Mark Code Knowledge Profile (WK)	Complex Problem Solving (WP)	Complex Engineering (EA)	Mark Code	Percentage (%)
1	1	10	Direct Observation • Attendance (x 5%) • Team work (x 5%) • Communication & Interactions (x 5%)			1, 2, 3	LA-1	15
2	2	2	Experiment Proposal Report • 1report x 15 %	3	1, 3, 5		LR-1	15
3	3	9	Final Report • 1report x 70 %				LR-2	70
							Total	**100**
							4 experiments x 100	**400**

Any report found to be of plagiarism in nature will be given minimum mark of 0%.

8.0 STAFF

Student	Academician
3 BMCG (S1, S2, S5)	Name: IMRAN SYAKIR BIN MOHAMAD Room No.: 8/6/9 Phone No.: 06-2704472 | 019-5075710 E-mail: imran
3 BMCG (S3, S4)	Name: MRS ANITA AKMAR BINTI KAMAROLZAMAN Room No.: 8/6/42 Phone No.: 06-2704372 | 018-9766079 E-mail: anita
3 BMCG (S8) 2BMCK (S1, S2)	Name: DR. MUHAMMAD ZULFATTAH BIN ZAKARIA Room No.: 8/7/45 Phone No.: +6062704437 | 019-2440019 E-mail: zulfattah

Lab	Assistant Engineer
STRUCTURE MECHANIC LAB	Name: MR. WAN SAHARIZAL WAN HARUN Room No.: MD Phone No.: 013-2782029 E-mail: saharizal
DYNAMIC LAB	Name: MR. FAIZOL KAMARUL ZAHARI Room No.: MD Phone No.: 019-6655316 E-mail: faizol
AIR-CONDITIONING LAB	Name: MR. ASJUFRI MUHAJIR Room No.: MPU Phone No.: 012-6104165 E-mail: asjufri
HEAT TRANSFER LAB	Name: MR. FAIZAL JAAFAR Room No.: MPH Phone No.: 016-6459903 E-mail: faizaljaafar
FLUID MECHANIC LAB	Name: MR. IKHMAL HISHAM IBRAHIM Room No.: MKB Phone No.: 019-6264559 E-mail: ikhmal

9.0 LAB ACTIVITIES SCHEDULES

LAB SCHEDULE

WEEK	W1	W2	W3		W4		W5		W6	W7		W8	W9	W10	W11	W12	W13	W14	W15
DATE	20.3-24.3	27.3-31.3	3.4-7.4		10.4-14.4		17.4-21.4		24.4-28.4	1.5-5.5		8.5-12.5	15.5-19.5	22.5-26.5	29.5-2.6	5.6-9.6	12.6-16.6	19.6-23.6	26.6-30.6
EXP		LAB 1	LAB 2	LP1	LAB 3	LP2	LAB 4	LP3		LR1	LP4	LR2	LR3	LR4					
S1	ONLINE LAB BRIEFING	A	C	LAB 1 PROPOSAL SUBMISSION	E	LAB 2 PROPOSAL SUBMISSION (INDIVIDUAL)	D	LAB 3 PROPOSAL SUBMISSION	MID-TERM BREAK	LAB 1 REPORT SUBMISSION	LAB 4 PROPOSAL SUBMISSION	LAB 2 REPORT SUBMISSION (INDIVIDUAL)	LAB 3 REPORT SUBMISSION	LAB 4 REPORT SUBMISSION					
S2		I	K		G		L												
S3		B	D		F		E												
S4		J	L		H		G												
F1		C	E		A		F												
F2		K	G		I		H												
F3		D	F		B		C												
F4		L	H		J		K												
T1		E	A		C		B												
T2		G	I		K		J												
H1		F	B		D		A												
H2		H	J		L		I												

*A, B, C, D, E, F, G, H, I, J, K, L - students' lab group

Air conditioning Lab	
Cooling and Dehumidification Process	T1
Water Cooling Tower System	T2

Heat Transfer Lab	
Linear Heat Conduction	H1
Radial Heat Conduction	H2

Dynamic Lab	
Stress Strain Analysis of a Simple Beam	S1

Structure Mechanics Lab	
Thin-Thick Cylinder Analysis	S2
Curved Bar Davits Test	S3
Strut-Buckling	S4

Fluid Mechanics Lab	
Boundary Layers	F1
Drag Measurement	F2
Laminar Flow Visualization	F3
System and Pump Characteristics	F4