Thermodynamics Lab

Lab Course: **Thermodynamics** – I

List of Experiments:

1. Layout of Thermodynamics laboratory
2. Calibration of Bourden Tube Pressure Gauge.
3. To investigate the first law and Second law of thermodynamic using heat Engine
4. To investigate the relation between pressure and temperature of Saturated Steam using Marcet Boiler.
5. Study of Steam Bench
6. Determination of Dryness Fraction of Steam using Steam Bench.
7. Study of the processes of Heat Engine
8. Study of the Steam Engine.
9. Study of the 2 Stroke Petrol Engine.
10. Study of the 4 Stroke Petrol Engine.
11. Study of the 4 Stroke Diesel Engines.
12. Study of the Wankel Engines.

Thermodynamics Lab

Lab Course: **Thermodynamics** - II

List of Experiments:

1. Study of Convergent / Divergent Nozzles.
2. To determine the Critical Pressure Ratio (convergent - divergent pressure ratio) and the demonstration of the choking effect.
3. To determine the flow rate using convergent nozzle.
4. To determine the nozzle thrust.
5. To determine the efficiency of nozzle.
6. To investigate the performance characteristics of two stage Air Compressor.
7. To determine the pressure losses in pipes with different sizes of profile.
8. To determine the Airflow rate using Orifice Flow measuring devices.
9. To determine the indicated work of Air Compressor (1st Stage only) from P-v diagram
10. Study of the steam turbine.
11. Study of the fire tube boiler.
12. Introduction of the Rankine Cycler (Power plant)

Thermodynamics Lab
Lab Course: **Power Plant.**
List of Experiments:

1. To Study the 2 Shaft Gas Turbine
2. To Study the Rankine Cycler Power Plant
3. To Analyze the System Efficiency (Rankine Cycler Power Plant) and Following Parameters:
    - Energy Relationships and First Law of Thermodynamics,
    - Control Volume Analysis,
    - Entropy Analysis,
    - Isentropic Analysis and study of Turbine/Nozzle Efficiency
    - Heat Transfer Analysis and Study of Boiler Efficiency
    - Combustion Processes
    - Vapor Power System Fundamentals
    - Electrical Power Generation
    - Experimental and Data Acquisition Techniques
4. To Study the single Cylinder Steam Engine
5. To Analyze the System Efficiency and the following Parameters:
    - Recording of Vapor Pressure Curve
    - Determination of the Fuel Consumption
    - Determination of the Amount of Steam Generated
    - Determination of the Power Output
    - Determination of the Boiler Efficiency
    - Determination of the Condenser Performance

Fracture & Fatigue lab

Lab Course: **Stress Analysis**

List of Experiments:

1. Study of the Polari scope.
2. To determine the material fringe value of photo elastic model.
3. To find the sensitivity of Wheatstone bridge via gauge factor "k" of strain gauge.
4. To find the value of stress in case of bending beam.
5. To determine the value of Torsion Moment produced in a given torsion bar.
6. Comparison of experimental and analytical stress in a bar under tension by using strain gauges.

Modeling & Simulation lab

Lab Course: **FEM**

List of Experiments:

1. Introduction to FEM and ANSYS.
2. Analysis of a cantilever beam.
3. Analysis of a simple truss.
4. Analysis of 2d C - section.
5. Analysis of a bicycle frame.
6. Plane truss bracket.
7. Structural analysis of water tank exposed to high speed wind.
8. Temperature distribution in a plate.
9. Modal analysis of model plane wing.
10. Application of distributed load.

Modeling & Simulation lab

Lab Course: **Computer Programming**

List of Experiments:

1. Write a program to find the mass of the earth using Define statement.
2. Write a program to find the density of the body.
3. Write a program to find the Volume of the body.
4. Write a program to find the weight of the body.
5. Write a program to find the distance of the body by using the relation $S = V_i t+1/2 * a * t^2$
   $S = (V_f^2 - V_i^2)/ (2*a)$
6. Write a program to read the temperature in Fahrenheit and convert the temperature to degree Celsius by using formula
   C=5/9(F-32)
7. Write a program to find if the input number is odd or even.
8. Write a program to find if year entered is a leap year.
9. Write a program using nested if to find if all the 3 numbers entered through keyboard are equal.
10. Write a program to print number from 10 to 1 in descending order.
11. Write a program to generate table of n numbers.

12. Write a program to find factorial of n numbers.
13. Write a program to find if the input number is prime.
14. Enter 10 numbers in an array and display them in ascending order.
15. Sort the array in descending order.
16. Find the smallest number in the array.
17. Write a program to convert Fahrenheit to Centigrade using all three methods of functions.
18. Write a program to calculate distance covered by the body using all three methods of functions.

Mechanics of Material lab

Lab Course: Mechanics of Material -I

List of Experiments:

1. To study the Hook's law.
2. To determine the hardness of different materials (mild steel, brass, copper, aluminum).
3. To compare the experimental and theoretical deflection of given beam specimen in simply supported.
4. To determine the shear stress, shear strain and find out the modulus of rigidity of rubber slab.
5. To compare the experimental and theoretical deflection of a given beam specimen in cantilever.
6. To study the use of vernier calipers.
7. To find out the shear modulus (G) and shear stress (q) for the given shaft specimen on torsion apparatus.
8. To find out the Young's Modulus of Elasticity (E) of given beam specimen in simply supported.

Mechanics of Material Lab

Lab Course: Mechanics of Material -II

List of Experiments:

1. To find out the Young's Modulus of Elasticity (E) of given specimen in cantilever.
2. To compare the theoretical Angular twist with experimental values for compound shaft.
3. To determine the diameter at vertical deflection of the circular ring and compare the experimental result with that of theoretical values.
4. To find the reaction of a simply supported beam.
5. To compare the experimental and theoretical horizontal deflection of the circular ring.
6. To determine the tensile strength, yield point strength, %elongation of given test specimen.
7. To find out the modulus of rigidity (G) and shear stress (Fs) of closed coil helical spring.

Mechanics of Machines

Lab Course: Mechanics of Machines - I

List of Experiments:

1. layout of M.M.C. lab
2. To find mechanical advantages, velocity ratio efficiency, and friction of simple gear train.
3. To find mechanical advantages, velocity ratio efficiency, and friction of compound wheel and axle with bearing.
4. Determine the controlling force of a Porter Governor.
5. To determine the coefficient of friction for some materials.

6. To determine the coefficient of friction between screw and nut for square threads using screw jack.
7. To find mechanical advantages, velocity ratio, efficiency of screw jack using as lifting machine and also torque transmitted.
8. To find mechanical advantages, velocity ratio efficiency, and friction of compound wheel and axle without bearing.
9. Investigate the effect of axial force on the coefficient of friction in case of single plate clutch plate using uniform pressure theory and uniform wear theory. Also find the maximum pressure and minimum pressure.
10. Determine the controlling force of a porter Governor. Plot a characteristics curve of a controlling force against sleeve lift and compare exponential result with the theoretical result and also calculate governor effort, sensitivity and coefficient of in sensitivity and coefficient of sleeve position.

Fracture & Fatigue Lab

Lab Course: Mechanical Vibrations

List of Experiments:

1. Layout of the Mechanical Vibration Laboratory.
2. To calculate the time period of rod pendulum and compare these experimental results with the calculated results. Also check its dependency on length and displacement.
3. To determine the spring constant 'k'.
4. To find the natural frequency of a spring mass system in case of un-damped free vibration by using mechanical vibration Apparatus. Compare theoretical and experimental results.
5. To show that damped natural frequency (in case of damped free vibration) is lower than natural frequency (in case of un-damped free vibration)
   To show that resonance occurs only when forced frequency is equal to natural frequency (i.e. doesn't occur either forced frequency is smaller or greater than natural frequency) in the case of un-damped forced vibration.
6. To find the natural frequency of a torsional system (shaft having circular disk at the end) in case of un-damped free vibration by using Mechanical Vibration Apparatus.
7. To study the software Labview to analyze any system.

Fracture & Fatigue Lab

Lab Course: Manufacturing Process I

List of Experiments:

1. Layout of Workshops
2. Types of welding, demonstration of Electric Arc Wielding and its application.
3. Spot Wielding and its applications.
4. Visit of HMC Fabrication shop and understanding of Fabrication drawings and symbols.
5. Development of pattern and mold for casting.
6. Melting Aluminum and pouring in into the mold to cast a part.
7. Drawing of metallic sheets using hydraulic press

Modeling & Simulation Lab

Lab Course: Machine Design & CAD

List of Experiments:

1. Introduction to 3D modeling, difference between 3D - Solid and 3D - Surface modeling.
2. Introduction to UCS, its importance and application.
3. Concept of layers.
4. Introduction to boundary, region, & pedit command and differentiate between them.
5. Introduction to model space and paper / layout space.
6. 3D built in functions as box, sphere, cylinder, cone, wedge, and torus.
7. Introduction to extrude command and its parameters.
8. Introduction to resolve command in 3D solid and 3D surface modeling and difference between them.
9. Introduction to slice, section and interface.
10. Application of fillet and chamfer in 3D.
11. Introduction to 3D - array, 3D - rotate and 3D - mirror.
12. Introduction to align command.
13. Introduction to surface modeling, its parameters like surftab1, surftab2, edge surface, ruled surface, tabulated surface, revolve surface.
14. Introduction to solid editing.
15. Introduction to block diagram, its importance and application in engineering drawing.
16. Introduction to rendering, its different options / commands, attaching colors, transparency of the model.
17. Introduction to placing dimensions in 3D solid modeling, to set its variables.
18. Introduction to make slides in AutoCAD, how to run it in AutoCAD environment.
19. Introduction to create Orthographic projections from an isometric view.
20. Introduction to Auto Lisp programming.
21. Introduction to Pro - Engineering.

Assembly drawings for students practice:

1. Grinding Arbor
2. Non - Return Valve
3. Connecting Rod
4. Bell - Roller Support
5. Friction Grip OR Compression Coupling
6. Knuckle Joint
7. Upper part of a Boiler Stop Valve
8. Inverted Bearing
9. Pedestal Bearing
10. Plumber Block
11. Locomotive Piston and Rod
12. Anti - Vibration mount

13. Awning Pulley
14. Sliding Door Guide
15. RowLock

Refrigeration & Air Conditioning

Lab Course: Refrigeration & Air Conditioning

List of Experiments:

1. Refrigeration trainer & fault Simulator

- Introduction
- No fault condition
- Fault No.1 Compressor.
- Fault No.2 Oil Separator.
- Fault No.3 Shortage of refrigerant.
- Fault No.4 Constant Pressure Regulator.
- Fault No.5 Blocked Freezer Evaporator or Liquid Line.
- Fault No.6 Restricted Freezer Liquid Line.
- Fault No.7 Blocked Refrigerator Evaporator or Liquid Line.
- Fault No.8 Restricted Refrigeration Liquid Line.
- Fault No.9 Faulty Check Valve.
- Fault No.10 Freezer TEV.
- Fault No.11 Refrigerator TEV.
- Fault No.12 Partially Blocked Drier.
- Fault No.13 Blocked Condenser Air Path.
- Fault No.14 Short Cycling.

2. Reverse Cycle Air-Conditioning Trainer

- Cooling Cycle using TXV as an expansion device.
- Cooling Cycle using AXV as an expansion device.
- Capillary tube as an expansion device.
- Indoor Heat Exchange Performance (Cooling cycle)
- Indoor Heat Exchange Performance (Heating cycle)
- Fault No.1 Indoor fan speed control faulty.
- Fault No.2 Main power Switch faulty.
- Fault No.3 Indoor fan motor faulty.
- Fault No.4 Overload protector faulty.
- Fault No.5 HPC faulty.
- Fault No.6 LPC faulty.
- Fault No.7 Mode switch faulty.
- Fault No.8 Outdoor fan speed control faulty.
- Fault No.9 Solenoid valve relay coil faulty.
- Fault No.10 Reversing valve coil faulty.

Refrigeration & Air Conditioning

Lab Course: Heat Mass & Mass transfer

List of Experiments:

1. Heat Conduction Apparatus
    - Study of heat conduction
    - Conduction along a simple bar
    - Conduction along a composite bar
    - Effect of cross-sectional area
    - Radial conduction
    - Effects of surface contact
    - Insulation effects
2. Free & Forced convection Heat Transfer Apparatus
    - To demonstrate the relationship between power input & surface temperature in free convection.
    - To demonstrate the relationship between power input & surface temperature in forced convection.
    - To demonstrate the use of extended surfaces to improve heat transfer from the surface.
    - To demonstrate the temperature distribution along an extended surface.
    - Compression of horizontal & vertical flat plate in free convection.
3. Thermal Radiation Apparatus
    - To show that the intensity of radiation on a surface is inversely proportional to the square of the distance of the surface from radiation source.
    - To show that the intensity of radiation varies as the fourth power of the source temperature.
    - To demonstrate the emissivity of the different surfaces. (Polished, silver anodized, matt black)
    - To demonstrate how the emissivity of the radiation surfaces in proximity to each other will affect the surface temperatures and the heat emptied.
    - To demonstrate the validity of Kirchhoff's law which states that the emissivity of a grey surface is equal to its absorptivity of radiation received from another surface when in a conduction of thermal equilibrium.
    - To demonstrate that the exchange of radiant energy from one surface to another is dependent upon their interconnecting geometry, i.e. a function of the amount that each surface can 'see' of the other.
    - To show that the luminance of the surface is inversely proportional to the square of the surface from the light source.
    - To show that the energy radiated in any direction at any angle with a surface is equal to normal radiation multiplied by the cosine of the angle between the direction of radiation and the normal to the surface.
    - To show that the light passing through non-opaque is reduced in intensity in proportion to the thickness and absorptivity of the material.
4. Heat Exchanger Training Apparatus:
    - Counter-current shell & tube heat exchanger.
    - Co-current shell & tube heat exchanger.
    - Co-current spiral heat exchanger.
    - Co-current concentric heat exchanger.
    - Counter-current plate heat exchanger.
    - Co-current plate heat exchanger.

Thermodynamics Lab

Lab Course: **Internal Combustion Engines**

List of Experiments:

1. To measure the mass flow rate of fuel of slow speed diesel engine.
2. To find the B.H.P (Brake Horse Power) of slow Speed Diesel Engine.
3. To determine the engine performance at throttled condition and to prepare the engine performance curve of 2 stroke Gasoline engine.
4. To determine the engine performance at partial throttled as well as partial load condition of 2 stroke Gasoline engine.
5. To determine the engine performance at throttled condition and to prepare the engine performance curve of 4 stroke gasoline engine.
6. To determine the engine performance at partial throttled as well as partial load condition of 4 stroke gasoline engine.
7. To determine the engine performance at throttled condition and to prepare the engine performance curve of 4 stroke diesel engine.
8. To determine the engine performance at partial throttled as well as partial load condition of 4 stroke diesel engine.

Fluid Mechanics and Hydraulics Lab

Lab Course: **Gas Dynamics**

List of Experiments:

1. Study of wind tunnel.
2. Determine the lift and drag coefficients of symmetric airfoils by using sub sonic wind tunnel.
3. To observe and study the flow analysis and aerodynamic behavior of a sphere.
4. To study the boundary layer and visualize it on wind tunnel.
5. To study the aerodynamic behavior of airship specimen.
6. To study the aerodynamic behavior of solid and hollow circular disc.

Fluid Mechanics and Hydraulics Lab

Lab Course: **Fluid Mechanics** - I

List of Experiments:

1. Layout of fluid mechanics lab.
2. To determine the flow rate of a fluid by using venture-meter on a compressible flow bench apparatus.
3. To determine the depth of center of pressure of an immersed surface.
4. To determine the meta-centric height of a floating body.
5. To demonstrate Bernoulli's law by using Bernoulli's principle demonstrator.
6. To determine the hydraulic coefficients in flow through orifices.
7. To determine the time of emptying a tank with an orifice at its bottom.

Lab Course: **Fluid Mechanics** – II
List of Experiments:

1. Determine the flow rate by using centrifugal pump and draw characteristics curves.
2. Series and parallel operation of twin centrifugal pump configuration.
3. To study and draw characteristics curve of Francis turbine.
4. To study and draw characteristics curve of Pelton turbine.
5. To study and draw characteristics curve of Impulse turbine.
6. To study the Reaction turbine using data acquisition system.
7. To study the Impulse turbine using data acquisition system.

Lab Course: **Engineering Dynamics**

Engineering Mechanics Lab

List of Experiments:

1. To determine the mechanical advantage of an inclined plane by drawing a graph between Wand P.
2. To study and determine the mechanical advantage of a screw jack and to calculate torque M and M1.
3. To compare the efficiencies of a square thread and V - thread.
4. To determine the moment of inertia of a flywheel by a falling weights method.
5. To find the velocity ratio, mechanical advantage and the load lost in friction and the efficiency of worm and worm wheel.
6. To find the velocity of ratio mechanical advantage, load lost in friction and efficiency of a western differential pulley.
7. To verify the relationship between angular and linear velocity.
8. This experiment has three parts:
    a. To resolve, by experiment, the combination of the three static co-planner forces which exist in loaded derrick crane.
    b. To compare the experimental results with the graphical solution obtained by constructing triangle of forces diagram.

Engineering Mechanics Lab

Lab Course: **Engineering Statics**

1. To verify the principle of moments, which states that if a number of co-planner, forces acting on a body, keep it in equilibrium and their moments are taken about any point in their plane, the sum of the clockwise moments is equal to the sum of the anti-clockwise moments.
2. To determine the reaction of a beam under various loadings.
3. To verify the laws of friction between solid bodies and to find the coefficient of friction between wool and various other materials.
4. To find the tensions in various parts of a hanging rope loaded at various points.
5. To verify the law connecting the coefficient of friction between a cord and drum and angle of lap.
6. This experiment three parts:

a. To resolve by experiment, any suitable combination of three static co-planner forces.
b. To compare the results with the graphical solution obtained by drawing a triangle of forces diagram.
c. To illustrate the "resultant" of two of the forces and to compare the magnitude and direction of its equal and opposite "equilibrant" with the experimental values.

7. If a system is in equilibrium under several co-planner concurrent forces:
   a. The forces on their free vectors must form a closed polygon.
   b. To verify the condition of:
      i. $\sum Fx = 0$
      ii. $\sum Fy = 0$

CAD Lab
Lab Course: Engineering Economics

1. Introduction to Excel Financial Functions.
2. Find the PW for the following cash flow @ I = 8%

End of year	0	1	2	3	4
Cash Flow	-500	200	50	50	50

3. A foundation gives a gift to activity to build a park and to maintain it for 5 years. Annual interest is 8% and the annual maintenance cost is expected to be $1600 per year for 1st two years, increasing to $25000 per year after 2 years. What is the amount of gift received at present that will be required to continue maintenance of the park?
4. Find IRR for the following cash flow.

End of year	0	1	2	3	4
Cash Flow	-800	100	200	300	400

5. A machine tool company is considering a new material cutting machine. The required initial investment of $76000 and the project can benefit over the project 4 years life are as follows:

End of year	0	1	2	3	4
Cash Flow	-76000	35560	37360	31850	34400

You have been asked by the president of the company to evaluate the economic merit of the acquisition @ I = 12%.

6. Make an annual contribution of $3000 to your saving account at the end of each year for 10 years. **If** the account earns 7% interest annually, how much can be withdrawn at the end of 10 years.
7. Linear Programming

Renewable Energy Lab

Lab Course: **Energy Resources & Utilization**

List **of** Experiments:

1. Introduction to LEAP Software.
2. Key Variable analysis of Pakistan.
3. Energy demand analysis of Pakistan for household sector.
4. Energy demand analysis of Pakistan for industrial sector.
5. Energy demand analysis of Pakistan for transport sector.
6. Energy demand analysis of Pakistan for commercial sector.
7. Assessment of Solar Radiation Potential using Solar Radiation Monitoring System.
8. Indoor Investigation of Solar Panels using Artificial Solar Simulator.
9. Calculation of power and Load for Solar PV system.
10. Design and Economics of Solar PV System.
11. Determining the most efficient photovoltaic array location using Solar Path Finder.
12. Performance Analysis of Steam Power Plant.
13. Performance Analysis of Kaplan Turbine on Multi Turbine Test Set.
14. Performance Analysis of Francis Turbine on Multi Turbine Test Set.
15. Performance Analysis of Pelton Turbine on Multi Turbine Test Set.
16. Assessment of Wind Potential.

Renewable Energy Lab

Lab Course: **Measurements & instrumentation**

List of Experiments:

1. Measurement of solar radiations at UET Taxila using Solar Radiation Monitoring System
2. Measurement of weather conditions at UET Taxila using Weather Station.
3. Measurement of Temperature using Thermocouple Probes & Infrared Thermometer (Fluke 62 MAX).
4. Measurement of Temperature using Thermal Imager (Fluke Ti100).
5. Measurement of Close Channel Flow rate using Ultrasonic Flow Meter.
6. Measurement of Open Channel Flow rate using Open Channel Flow Meter.
7. Measurement of Luminosity using Light Meter.