THERMAL ENGINEERING LABORATORY- I

AIM:

To train the students with principle and operation of thermal Energy based systems.

OBJECTIVES:

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS:

I.C. ENGINE LAB AND FUELS LAB

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4-stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Morse Test on Multicylinder Petrol Engine.
5. Retardation Test to find Frictional Power of a Diesel Engine.
6. Determination of Viscosity – Red Wood Viscometer.
7. Determination of Flash Point and Fire Point.

STEAM LAB

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

LIST OF EQUPMENTS :

1. I.C Engine – 2 stroke and 4 stroke model 1 set
2. Red Wood Viscometer 1 No.
3. Apparatus for Flash and Fire Point 1 No.
4. 4-stroke Diesel Engine with mechanical loading. 1 No.
5. 4-stroke Diesel Engine with hydraulic loading. 1 No.
6. 4-stroke Diesel Engine with electrical loading. 1 No.
7. Multi-cylinder Petrol Engine 1 No.
8. Single cylinder Petrol Engine 1 No.
9. Data Acquisition system with any one of the above engines 1 No.
10. Steam Boiler with turbine setup 1 No.

AATTE01 VALVE TIMING DIAGRAGM AND PORT TIMING DIAGRAMS I.C ENGINE – 2 STROKE)

INTRODUCTION & DESCRIPTION:

In the case of two stroke cycle engines the inlet and exhaust valves are not present. Instead, the slots are cut on the cylinder itself at different elevation and they are called ports. Two-stroke engine's running is controlled by the sequence of port openings. The timing of these ports are given w.r.t the TDC and BDC of the engine.

Three ports are present in the two stroke cycle engine:-

1. Inlet port
2. Transfer port
3. Exhaust port

UTILITIES REQUIRED:

- Floor space required: 3' x 3'
- No electrical supply required
- Fixed protractor

TECHNICAL DETAILS:

SPECIFICATIONS:

Model : Ps-2-Stroke
Type: Air Cooled, 2-Stroke, Single Cylinder (Mix 40:1)
Max. Power Output (Hp/Rpm) 3/3800
Crank Speed (Rpm) 3800
Ignition System Transistor Controlled Ignition (Tci)
Starting Mode Recoil Start

FEATURES:

EPO to EPC – Exhausts
TPO to TPC – Charging
EPC to TDC – Compression
TDC to EPO – Expansion
EPO – Exhaust Port Open (35^o to 50^o before BDC)
EPO – Exhaust Port Open (35^o to 50^o before BDC)
EPC – Exhaust Port Close (35^o to 50^o after BDC)
TPO – Transfer Port Open (30^o to 40^o before BDC)
TPC – Transfer Port Close (30^o to 40^o after BDC)

RANGE OF EXPERIMENTS :

- To study the port timings of the 2-stroke Petrol engine
- To measure the degree using protractor fixed and verify the readings

AATTE02 VALVE TIMING DIAGRAGM AND PORT TIMING DIAGRAMS I.C ENGINE – 4 STROKES

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INTRODUCTION & DESCRIPTION:

Points of valve opening and closing are given as distances from TDC of the piston which can be measured in the cylinder. Engines with internal flywheels can have dot marks made on these against a reference dot in the crankcase.

UTILITIES REQUIRED:

- Floor space required: 3’ x 3’
- No electrical supply required
- Fixed protractor

TECHNICAL DETAILS:

Type : 4 stroke, naturally aspirated, direct injection, Water-cooled diesel engine
Engine capacity (cc) : 611

Power (HP @ rpm): 11 @ 3000

Torque (Nm @ rpm): 31 @ 1600-1800

No. of cylinders: Single

Fuel : Diesel

FEATURES:

Four-stroke timing is:

- Inlet opens at TDC; closes 45 deg. after BDC
- Exhaust opens 50 deg. before BDC; closes 10 deg after TDC

RANGE OF EXPERIMENTS :

- To study the Valve timings of a 4-stroke Diesel Engine
- To measure the degree using protractor fixed and verify the readings

AATTE03 REDWOOD VISCOMETER

INTRODUCTION & DESCRIPTION:

The redwood viscometer (AATTE03) consists of vertical cylindrical oil cup with an orifice in the centre of its base. The cylindrical cup is surrounded by the water bath. The water bath maintains the temperature of the oil to be tested at constant temperature. The oil is heated by heating the water bath by means of an immersed electric heater in the water bath, to maintain the uniform temperature in the water bath and to place the thermometer ti record the temperature of oil and water bath. This viscometer is used to determine the kinematic viscosity of the oil.

UTILITIES REQUIRED:

- Redwood Viscometer
- Thermometer 0-100°c (2 Nos)
- Stop watch
- 50 ml standard narrow necked flask
- Given Sample of oil

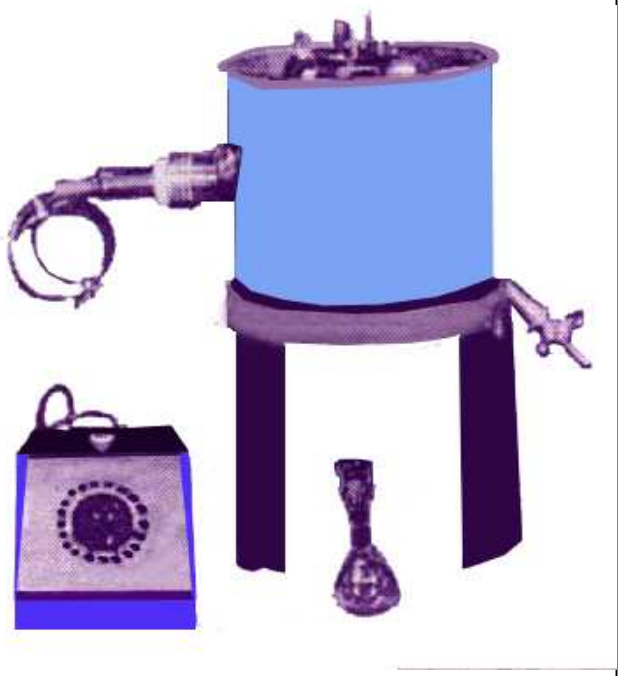
TECHNICAL DETAILS:

SPECIFICATIONS:

- Cylinder diameter: 47.625mm
- Depth: 88.90mm
- Orifice diameter: 1.70mm
- Orifice length: 12mm

RANGE OF EXPERIMENTS :

- Determination of the kinematic viscosity and absolute viscosity of the given lubricating oil at different temperatures



AATTE04 APPARATUS FOR FLASH AND FIRE POINT

INTRODUCTION & DESCRIPTION:

This flash point and fire-point test method using AATTE04 is a dynamic method and depends on definite rates of temperature increases to control the precision of the method. During the entire heating period, the test flame is moved across the sample at suitable intervals. The expected flash point of a specimen can thereby be found in a time saving and economical manner.

UTILITIES REQUIRED:

Standard Cup with brass handle
Temperature Probe Pt-100
Electric Gas Igniter with connector cable and plugs
Flame Detection Unit
Flame Arrest Cover

TECHNICAL DETAILS:

- Temp. Range: Ambient to 400°C with RTD sensor.
- Flame-Detector: Ionization principle based flame-detector sensor.
- Stirrer: 60 Rpm, A.C. 230 v, 50 Hz.Synchronous motor.
- Controller: Microprocessor based process controller cum indicator with 3-wire RTD temperature sensor, free potential flame detector sensor as i/p and 230 v triac as relay o/p.
- Lid-Closing Motor: 60 Rpm, A.C. 230 v, 50 Hz, synchronous motor for de-combustion.
- Assembly up/down: Motorized 12 v D.C. jack for ease-of-use.
- Flame-Sampling Arrangement: 10 Rpm, D.C. 12 v, gear motor, vertical movement reciprocating motion.
- Heater: 800 W, 230 v.
- Electrical ignition for flame-sampling. Ignition transformer having continuous o/p of 10.6 Kv. D.C. from 230 v A.C. i/p.
- Equipment Overall Size (LxWxH): 24â€x14â€x31â€
- Equipment Gross Weight: 21 Kg.
- Supply: 230 v, 1-Ã¸, 50 Hz supply with proper earthing system.

RANGE OF EXPERIMENTS :

- To determine flash and fire point of given sample within the range of 79° to 400° C

AATTE05 RETARDATION TEST TO FIND FRICTIONAL POWER OF A DIESEL ENGINE

INTRODUCTION & DESCRIPTION:

This test involves the method of retarding the engine by cutting the fuel supply. The engine is made to run at no load and rated speed by taking all usual precautions. When the engine is running under steady operating conditions, cut the fuel supply and simultaneously start taking time offal in speed say 20%, 40%, 60%, 80% of the rated speed. (For convenience 50% may be chosen i.e. 300rpm) The test is repeated at different loads.

UTILITIES REQUIRED:

- Tachometer
- Stopwatch
- Measuring tape

TECHNICAL DETAILS:

SPECIFICATIONS:

- Brake stand, temperature and air sensors are present in the base plate
- Brake stand arrangement provided with spring balance
- Fuel Measuring Arrangement is provided with burette
- Measuring device and manometer are mounted on panel

FEATURES:

- Speed is related to the frictional resistance inside the engine.
- Frictional power lost in the engine can be calculated

RANGE OF EXPERIMENTS:

- To conduct retardation test on a four-stroke single-cylinder diesel engine
- Mechanical loading with specified speed to calculate frictional power.

AATTE06 MORSE TEST ON MULTICYLINDER PETROL ENGINE

INTRODUCTION & DESCRIPTION:

For slow speed engine the indicated power is directly calculated from the indicator diagram. But in modern high speed engines, it is difficult to obtain accurate indicator diagram due to inertia forces, and therefore, this method cannot be applied. In such cases the Morse test can be used to measure the indicated power and mechanical efficiency of multi cylinder engines. The engines test is carried out as follows. The engine is run at maximum load at certain speed. The B.P is then measured when all cylinders are working

Then one cylinder is made in operative by cutting off the ignition to that cylinder. As a result of this the speed of the engine will decrease. Therefore, the load on the engine is reduced so that the engine speed is restored to its initial value. The assumption made on the test is that frictional power is depends on the speed and not upon the load on the engine.

UTILITIES REQUIRED:

- Tachometer

TECHNICAL DETAILS:

The Dynamometer used is a Hydraulic Dynamometer capable of absorbing a maximum load of 10 HP at a speed of 1500 RPM

The Loading device used is an AC Alternator of matching capacity to load the engine up to 10 HP at 1500 RPM along with Resistance loading arrangement for alternator.

The loading device used is an Eddy Current Dynamometer of matching capacity to load the engine up to 10 HP at 1500 RPM.

FEATURES:

- Frictional power is depends on the speed.
- Measure the indicated power and mechanical efficiency of multi cylinder engine.

RANGE OF EXPERIMENTS:

- To conduct Morse test on given multi cylinder petrol engine
- In order to determine the indicated power developed
- The each cylinder of the engine and to determine the mechanical efficiency.

AATTE07 HEAT BALANCE TEST ON 4-STROKE DIESEL ENGINE

INTRODUCTION & DESCRIPTION:

Energy supplied to an engine is the heating value of the fuel consumed. Only a part of this energy is transformed into useful work. The two main parts of heat not available for work are the heat carried away by the exhaust gases and the cooling medium.

Only up to 40% of the input energy to the IC engine is utilized to produce brake power. Remaining energy is lost through exhaust gas, lubricating oil, engine cylinder walls etc. Cooling water and exhaust gas carry away a major portion of energy. The total heat produced inside the cylinder must be equal to the sum of the various heat losses and the heat utilized for useful work. This is tabulated to get the heat balance sheet.

UTILITIES REQUIRED:

- Tachometer,
- Stopwatch,
- Thermometer,
- Measuring tape

TECHNICAL DETAILS:

SPECIFICATIONS:

- Engine Make
- Power (BP)
- Speed (N)
- Bore (B)
- Stroke (SL)
- Type of lubrication

FEATURES:

- Frictional losses and radiation losses come about 10% of total heat input
- The heat balance may be external or internal

RANGE OF EXPERIMENTS:

- To conduct a load test on an IC engine
- To study how the heat input to the engine is utilized.
- Prepare heat balance sheet, histogram and pie chart
- Using the experimental data obtained.

AATTE08 STEAM BOILER WITH TURBINE

INTRODUCTION & DESCRIPTION: A boiler is a closed vessel in which water or other fluid is heated. The heated or vaporized fluid exits the boiler for use in various processes or heating applications. In fire tube boiler, hot gases pass through the tubes and boiler feed water in the shell side is converted into steam. Fire tube boilers are generally used for relatively small steam capacities and low to medium steam pressures. The vertical boiler is a simple type which consists of a firebox at the bottom and a copper barrel with a smoke tube. It typically is used to drive stationary engines and boats. Firing is accomplished by alcohol or solid fuel pellets.

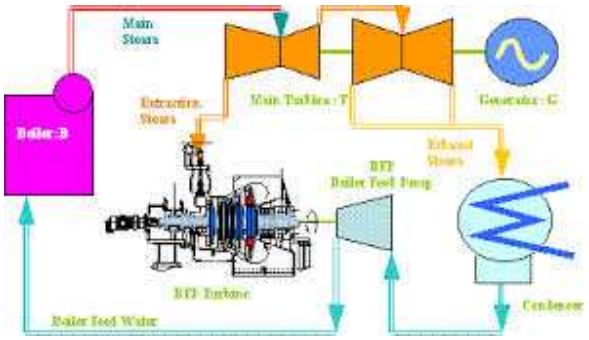
UTILITIES REQUIRED:

- Floor space required: 3' x 3'
- 3-phase electrical supply required

TECHNICAL DETAILS:

SPECIFICATIONS :

- Shell diameter 2.75 m
- Height 5.79 m
- Working pressure 6.5 bar (max. pressure = 15 bar)
- Steam capacity 3500 kg/hr (max. capacity = 4000 kg/hr)
- Heating surface 120 m^2
- Efficiency 70 to 75% (depending on the fuel used)



RANGE OF EXPERIMENTS:

- Study low/high pressure boilers, their accessories & mountings.
- heat balance sheet for boiler
- Study the working of impulse and reaction steam turbines.
- Find dryness fraction of steam by separating and throttling calorimeter.
- To find power output, condenser, volumetric & overall efficiency
- To study cooling tower and find its efficiency.

AATTE09 PERFORMANCE AND ENERGY BALANCE TEST ON A STEAM GENERATOR

INTRODUCTION & DESCRIPTION: A boiler or steam generator is used wherever a source of steam is required. The form and size depends on the application: mobile steam engines such as steam locomotives, portable engines and steam-powered road vehicles typically use a smaller boiler that forms an integral part of the vehicle; stationary steam engines, industrial installations and power stations will usually have a larger separate steam generating facility connected to the point-of-use by piping. A notable exception is the steam-powered fireless locomotive, where separately-generated steam is transferred to a receiver (tank) on the locomotive.

UTILITIES REQUIRED:

- Floor space required: 3' x 3'
- 3-phase electrical supply required

TECHNICAL DETAILS:

SPECIFICATIONS: A bench top unit which includes a gas fired steam generator for wet or superheated steam, a condensing unit with air ejector and a closed feed water system. Instrumentation to allow the measurement of all important quantities including air/fuel ratio, generator efficiency, steam properties and heat transfer quantities.
In addition, the module provides a supply of steam, condensate handling and air extraction facility for other bench top modules including the S210 Steam Turbine Module which may be simply connected to it.

RANGE OF EXPERIMENTS:

- Study low/high pressure boilers, their accessories & mountings.
- heat balance sheet for boiler
- Study the working of impulse and reaction steam turbines.
- Find dryness fraction of steam by separating and throttling calorimeter.
- To find power output, condenser, volumetric & overall

AATTE10 PERFORMANCE AND ENERGY BALANCE TEST ON STEAM TURBINE

INTRODUCTION & DESCRIPTION: A steam turbine is a device that extracts thermal energy from pressurized steam and uses it to do mechanical work on a rotating output shaft. Its modern manifestation was invented by Sir Charles Parsons in 1884. Because the turbine generates rotary motion, it is particularly suited to be used to drive an electrical generator – about 90% of all electricity generation in the United States (1996) is by use of steam turbines. The steam turbine is a form of heat engine that derives much of its improvement in thermodynamic efficiency from the use of multiple stages in the expansion of the steam, which results in a closer approach to the ideal reversible expansion process.

UTILITIES REQUIRED:

- Floor space required: 3' x 3'
- 3-phase electrical supply required

TECHNICAL DETAILS:

SPECIFICATIONS:

- Electricity, Energy, Generation, Micro, Power,Steam, Steam Turbine, Turbine,
- "VAMAN - The Midget" range of Micro Steam Turbines are available for as low as 1 KW to a maximum of 50 KW.
- The Steam Turbine is connected between the Boiler and the heater inlet. The steam operates the Turbine to Generate Power and the exhaust is connected to the Heater Inlet to heat up the rooms/barns, etc.

Thus without wasting the heat, you also get enough power to light up the house or use utilities.

RANGE OF EXPERIMENTS:

- Study low/high pressure boilers, their accessories & mountings.
- heat balance sheet for boiler
- Study the working of impulse and reaction steam turbines.
- Find dryness fraction of steam by separating and throttling calorimeter.
- To find power output, condenser, volumetric & overall