-Experiential learning-MEL0516/I C Engines

PBL Topic: To design and fabricate a test rig of Petrol Engine (in continuation with previous semester's work)

List of students who were actively involved in the activity-

1. BETN1ME23001-Krishna Baghel
2. BETN1ME22002 – Ramu Savita
3. BETN1ME22005- Sparsh jain
4. BETN1ME22006- Utkarsh Patil
5. BETN1ME22007- Kunal Gagre
6. BETN1ME22008- Nadukwe Johnson Jeremiah

Under the guidance of

Dr. Rajendra Singh Rajput
Associate Professor-ME/SoET

SOP:

Students will

1. draw the dimensions of base/foundation for fixing the engine as perthe engine size.

2. fabricate the base of the engine.

3. fix the engine on the base and then connect the engine with rope brake dynamometer existing in the lab after proper check of alignment and balancing.

4. also fabricate the air box and stand to fixthe thromocouple sensors and manometer.

Learning outcome:

1. He/she may learn the preliminary stage ofdrawing and design.

2. Students will learn fabrication processes like welding, fitting and metal working.

3. Students will be able to design and fabricate all the parts except engine through this PBL.

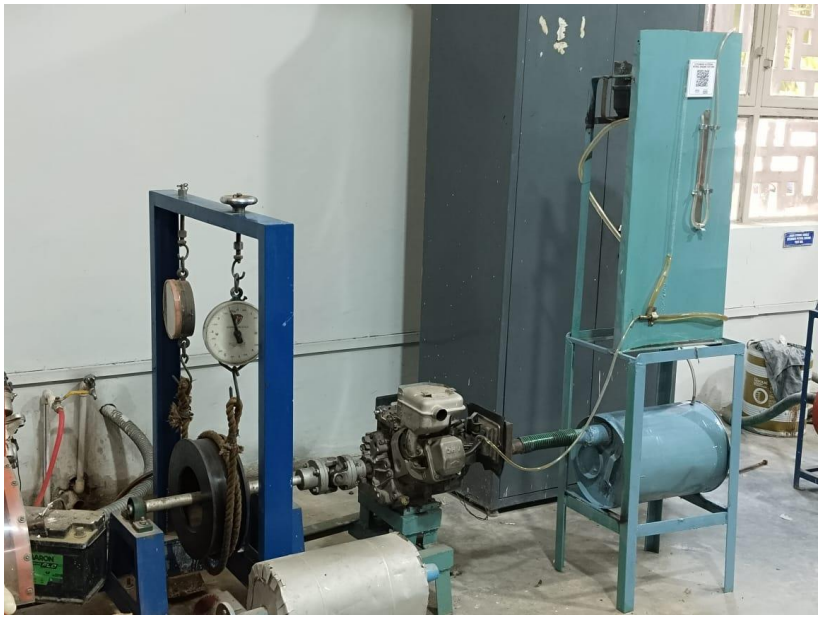
4. Students will also be able to plot the heat balance sheet to analyze the thermal and mechanical efficiency.

5. Through the testing, exhaust parameters may also be analyzed in order to increase the efficiency.

Course Outcomes- Course Outcomes 1-4 achieved through this PBL.

Progress Report of students-

1. Students designed and fabricated the base to install the engine.
2. The engine had been coupled with rope brake dynamometer.
3. The balancing of the engine and rope brake was checked by the students.
4. Air box set up for accessories like manometer, fuel tank, hose pipes, tubes etc. had been fabricated by the students.
5. The test rig is now fully functional and giving the right results which have been evaluated and analyzed. Results are also enclosed in the further details.



Rubrics for assessment:

Assessment is to done for the midterm marks (out of 20) on the basis of -

1. Degree of involvement in the project completion
2. Timely completion of the project
3. Accuracy of designing so that the working model is ready to be tested.
4. Results or outcome for testing of the engine to check its efficiency, power and heat balance sheet.

DESCRIPTION:

The apparatus consists of a Single cylinder four stroke petrol engine mounted on a sturdy frame. Loading arrangement is provided with the Electrical brake dynamometer, which is connected to theenginethroughacoupling.Specificarrangementhasbeenprovidewiththe equipment to measure the fuel & air consumption by the Engine.

TECHNICAL DETAILS:

Type of Engine: Single cylinder, four stroke, air cooled, Hand start, self lubricating petrol engine. (HONDA New)
Type of Loading: Electrical Dynamometer.

Fuel measuring system : Fuel measuring system consists of a fuel tank, a burette and a three way cock.

Air intake measuring system: Air tank fitted with orifice and water manometer.

The whole set up is well designed and supported by a good quality painted rigid M.S. Structure.

UTILITIES REQUIRED:

Petrol: 5Liters (Approx.)

Continuous water supply: 10LPM (approx)

FloorArea: 2mX 2m

Tachometer: For RPM measurement

PROCEDURE:
1. Clean the apparatus and fill sufficient amount of petrol to the fuel tank.
2. Checkout oil level in the engine. It should be up to the top edge of the flat portion of the dip stick. If the oil level is reduced & add clean engine oil to the crankcase by opening the valve cover the top of the engine.
3. Fill the water in the manometer tube up to half of its height.
4. Start the cooling water supply, to the brake drum.
5. Release the load From Engine before Starting.
6. Start the engine with starter.
7. Load the engine with Switch provided on panel and apply load up to a certain value (say 1kW).
8. Open the burette filling cock.
9. Take sufficient diesel on burette and close the cock. Note down the time required for 10 ml fuel consumption.
10. Note down the brake drum speed with tachometer and note down the manometer reading
11. Note down the cooling water flow rate and inlet, outlet temperature of water.

OBSERVATION:
DATA:

Density of water p_w=1000Kg/m³
Density of Air p_a = 1.21 Kg/m³
Density of fuel p_f = 840 Kg/m³

Bore diameter D_{Bore}= 85 x 10^{-3} m
Stroke length L_{Stroke} = 80 x 10^{-3}m
Brake drum diameter D=300x10^{-3}m
Rope Diameter d=18 x 10^{-3} m
Specific heat of water C_w= 4.2 KJ / Kg °K
Calorific value of diesel Cv=42000 KJ/Kg°K

OBSERVATION TABLE-

S. No.	Load (Kg)	RPM	Time for 10 ml fuel consumption (sec)	Manometer difference h (cm)
1.	1.5 kg	2223	11 sec	2 cm
2.	2.5 kg	2058	12 sec	2 cm
3.	3 kg	1434	13.3 sec	2 cm

Calculation

General Formula:

$$BP_T = \frac{2\pi NT}{60000}\ \text{kW}$$

(i) Fuel Consumption (F_s)

Formula:

$$F_s = \frac{x}{t} \times 10^{-6} \times \rho_f \times 3600 \text{ kg/hr}$$

Where: $x = 10 \text{ ml}$, $\rho_f = 720 \text{ kg/m}^3$

First Reading:

- Time (t) = 11 sec
- Calculation:

$$F_s = \frac{10}{11} \times 10^{-6} \times 720 \times 3600$$

$$F_s = 23.56 \text{ kg/hr}$$

Second Reading:

- Time (t) = 12 sec
- Calculation:

$$F_s = \frac{2.592}{12 \times 0.01} = 21.6 \text{ kg/hr}$$

Third Reading:

- Time (t) = 13.3 sec
- Calculation:

$$F_s = \frac{2.592}{13.3 \times 0.01} = 19.48 \text{ kg/hr}$$

(ii) Brake Power (BP)

First Reading:

- Load = 1.5 kg
- Force (F) = $1.5 \times 9.81 = 14.715\ \text{N}$
- Speed (N) = 2223 RPM
- Torque (T) = $F \times r = 14.715 \times 0.5 = 7.375\ \text{Nm}$
- Calculation:

$$BP = \frac{2\pi \times 2223 \times 7.375}{60000} = 1.713\ \text{kW}$$

Second Reading:

- Load = 2.5 kg
- Force (F) = $2.5 \times 9.81 = 24.525\ \text{N}$
- Speed (N) = 2058 RPM
- Torque (T) = $24.525 \times 0.5 = 12.265\ \text{Nm}$
- Calculation:

$$BP = 2.641\ \text{kW}$$

Third Reading:

- Load = 3 kg
- Force (F) = $3 \times 9.81 = 29.43\ \text{N}$
- Speed (N) = 1434 RPM
- Torque (T) = $29.43 \times 0.5 = 14.715\ \text{Nm}$
- Calculation:

$$BP = \frac{2\pi \times 1434 \times 14.715}{60000} = 2.211\ \text{kW}$$

(iii) Specific Fuel Consumption (S_{FC})

Formula:

$$S_{FC} = \frac{F_e}{BP}$$

First Reading:

$$S_{FC} = \frac{23.56}{1.713} = 13.75$$

Second Reading:

$$S_{FC} = \frac{21.6}{2.641} = 8.17$$

Third Reading:

$$S_{FC} = \frac{19.48}{2.211} = 8.81$$

(iv) Heat Supply By Fuel (H_f)

(Note: The report calculates this as mass divided by calorific value, appearing as M_f/C_v)

First Reading:

$$H_f = \frac{0.2356}{48000} = 0.00049 \text{ kJ/hr}$$

Second Reading:

$$H_f = \frac{21.6}{48000} = 0.00045 \text{ kJ/hr}$$

Third Reading:

$$H_f = \frac{19.48}{48000} = 0.00040 \text{ kJ/hr}$$

(v) Brake Heat (H_{BP})

Formula:

$$H_{BP} = BP \times 3600 \text{ kJ/hr}$$

First Reading:

$$H_{BP} = 1.713 \times 3600 = 616.6 \text{ kJ/hr}$$

Second Reading:

$$H_{BP} = 2.641 \times 3600 = 9508 \text{ kJ/hr}$$

Third Reading:

$$H_{BP} = 2.211 \times 3600 = 7958 \text{ kJ/hr}$$

(vi) Brake Thermal Efficiency (η_{BT})

Formula:

$$\eta_{BT} = \frac{H_{BP}}{H_f} \times 100\%$$

First Reading:

$$\eta_{BT} = \frac{616.6}{0.00049} \times 100 \approx 12\%$$

Second Reading:

$$\eta_{BT} = \frac{9508}{0.00045} \times 100 \approx 21.1\%$$

Third Reading:

$$\eta_{BT} = \frac{7958}{0.00040} \times 100 = 19.87\%$$

PRECAUTIONS & MAINTENANCE INSTRUCTIONS:

1. Before start the engine, oil level in sump and jacket cooling water supply must be checked
2. Never stop the engine on load.

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