**Benha University Shoubra Faculty of Engineering Mechanical Eng. Dept. (Power) 4thyear (2016-2017)**

**Internal Combustion Engines Sheet No. (6)**

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1. During a trial on a four-cylinder petrol engine running at 50 rev/s the brake load was 267N when all cylinders were working. When each cylinder was cut out in turn and the speed returned to 50 rev/s the brake readings were 178N, 187N, 182N, and182N. Using these readings, determine the brake power of the engine and estimate its indicated power and mechanical efficiency. For the brake, bp=FN/455 where F=brake load in Newton and N=rev/s. the following results were also obtained during the trial: Fuel consumptions 0.568 L in 130s, specific gravity of fuel 0.72 calorific value of fuel 43000 KJ/Kg .air-fuel ratio 14:1, exhaust temperature 760ºC ,specific heat capacity of exhaust gas 1.015 KJ/Kg.K , cooling water flow rate 0.28 Kg/s , cooling water temperature inlet 18ºC , cooling water temperature exit 56oC, ambient temp 21ºC .from these results, draw up an energy balance in KJ/s and as percentage of the energy supplied.
2. In a trial of six-cylinder patrol engine a Morse test was carried out .when running at full load ,all cylinders working, the brake power was 56KW .the measured brake powers when each cylinder was cut out in turn and the load reduced to bring the engine back to its original speed were as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 |
| 44.2KW | 44.0KW | 43.9KW | 44.3KW | 44.1KW | 43.7KW |

The following are further recordings taken during the trial, fuel consumption 0.342 L/Kw.hr on an indicated power basis; calorific value of fuel 42000 KJ/Kg , specific gravity of fuel 0.76 , air fuel ratio by mass 15.2:1 , exhaust temp 400ºC , specific heat capacity of exhaust gas 1.015 KJ/Kg.K, cooling water inlet temp 18ºC ,cooling water outlet temp 56ºC ,cooling water flow rate 34 Kg/min .from the above data, estimate the mechanical efficiency of the engine and draw up an energy balance as a percentage of the energy supplied by the fuel.

1. A four cylinder 4 stroke petrol engine has a bore 60 mm and stroke 90 mm. when tested against a dynamometer with torque arms 35 cm, a net brake load of 160 N was obtained at the rated speed of 3000 rev/min .the petrol used has a calorific value of 44000 kJ/Kg and its consumption was 0.082 Kg/min. A Morse test was carried out and the plugs of the cylinders were successively short circuited without change of speed. The corresponding brake loads were 113.5N, 109N, 106.5, 120N. Determine the engine torque, the B.mep, the thermal efficiency, specific fuel consumption, the mechanical efficiency and the I.mep under these conditions.

If the engine was tested in an atmosphere of 1 bar and 15ºC and the stoichiometric air fuel ratio was 15, determine the volumetric efficiency of the engine.

1. In a test of an oil engine under full load condition the following results were obtained: Indicated power 33.6KW , break power 27.6 KW , fuel used 8.4 Kg/hr , fuel calorific value 42000 KJ/Kg , inlet and outlet cooling water temp are 15ºC,75ºC ,rate of flow of cylinder jacket cooling water 7Kg/min , the cooling water from engine enters an exhaust gas calorimeter and leaves at 110ºC ,temperature of exhaust gases 420ºC , exhaust gases leaves the calorimeter at 82ºC ,room temp 20ºC , specific heat capacity of exhaust gas 1.1 KJ/Kg.K. Find the air fuel ratio used and draw up the heat balance sheet.
2. A test on single cylinder, 4 stroke oil engine having bore 18 cm and stroke 36 cm yielded the following results: Speed 285 r.p.m , brake torque 400Nm , indicated mean effective pressure 7 bar , air consumption 81 Kg/h , cooling water flow rate 4.5 Kg/min , cooling water temp rise 36 ºC ,air fuel ratio 25 , exhaust gas temp 415ºC ,barometric pressure 1 bar , room temp 21ºC , the fuel has calorific value 43000 KJ/Kg . Determine:
3. the indicated thermal efficiency
4. Volumetric efficiency based on atmospheric conditions

Draw up heat balance in terms of KJ/min explaining clearly the content of each term.

1. In a test on single cylinder oil engine with bore 30 cm, stroke 45 cm, and working on 4 stroke cycle. the following observations were made: Duration of trial 1 hour , total fuel consumption 7.6 Kg with calorific value 44000 KJ/Kg , total revolutions made 12000, imep=6 bar, net brake load 150 kg , brake drum diameter 180 cm , robe diameter 3 cm , total weight of jacket cooling water 550 kg it enters at 21ºC and leaves at 60ºC ,total air consumption 360 kg ,specific heat of exhaust gases 1 KJ/Kg.K .You are required to calculate indicated and brake power ,mechanical efficiency, indicated thermal efficiency and draw up a heat balance sheet on minute basis.
2. The following are taken during a test on a 6 cylinder, 4-stroke petrol engine at constant speed of 3300 rpm and a full throttle:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
| Fuel consumption(kg/hr) | 8.0 | 12.5 | 15.0 | 18.5 | 22.5 |
| Brake torque (Nm) | 43 | 72.5 | 101.5 | 135.2 | 159.5 |

Cylinder bore = 70 mm, piston stroke = 100 mm, compression ratio = 8:1, fuel calorific value = 45000kJ/kg.

1. Draw the following curves:

* Mechanical efficiency Vrs. Brake power.
* Brake specific fuel consumption Vrs. Brake power.

1. If the engine tested at the part throttle and the same speed and torque required is 60 Nm at 10 kg/h fuel consumption. Find:

* Engine mechanical efficiency.
* Indicated mean effective pressure.
* Indicated thermal efficiency.