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

**Internal Combustion Engines Sheet No. (7)**

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1. How the power and efficiency of the spark ignition engine vary with air/fuel ratio for different load and speed conditions?

2) Write a short note on the air –fuel ratio requirements of a petrol engine from no load to full load

3) Why a very rich mixture and rich mixture is required for idling and maximum power respectively?

4) With the help of a neat sketch explain the working principle of a simple carburetor.

5) Draw a curve representing variation of mixture requirements (F/A ratios) from no-load to full load in a spark ignition engine, mark the relative position of stoichiometric fuel-air ratio line and then explain why:

a) An idling engine requires a rich mixture;

b) A cruising engine requires an economy mixture;

c) Maximum power demands a rich mixture.

6) Explain why a simple carburetor cannot meet the various engine requirements.

1. Describe with suitable sketches the following systems of a carburetor:
2. Main metering systems
3. Idling system
4. Power enrichment or economizer system
5. Acceleration pump system
6. Choke

8) Derive an expression for air/fuel ratio

1. Neglecting compressibility
2. Taking compressibility into account

9) A spark ignition engine on test consumes 5kg/hr of petrol when running on air/fuel ratio of 16:1. The engine uses a single-jet carburetor having a fuel orifice area of 2sq mm and the tip of the jet is 5 mm above the level of petrol in the float chamber, when the engine is not running. Calculate the depression in the venture throat to maintain the required fuel flow rate through the carburetor. Assume specific gravity of petrol as 0.75and the coefficient of discharge of the fuel orifice as 0.8. What area of venture throat will be required to maintain the desired flow rate? Density of air is 1.2kg/m3 and the coefficient of discharge for venture throat is 0.8. Neglect compressibility of air.

10) The following data relate to a petrol engine:

Petrol consumed per hour=7.2kg, specific gravity of fuel=0.75, temperature of air=270C, air fuel ratio=15:1, diameter of choke tube=24mm, height of top of the jet above the petrol level (in the float chamber) =4.2mm, coefficient of discharge for air=0.8, coefficient of discharge for fuel=0.7, atmospheric pressure=1.013bar

Calculate the diameter of the fuel jet of a simple carburetor.

11) A simple carburetor under a certain condition delivers 5.45kg/hr of petrol with an air/fuel ratio 15:1. The fuel jet area is 2mm2 with a coefficient of discharge of 0.75. If the tip of fuel jet is 0.635cm above the level of petrol in the float chamber and the venture throat coefficient of discharge is assumed to be 0.8. Calculate:

a) The venture depression in cm of H2O necessary to cause air and fuel flow at desired rate

b) The venture throat diameter.

c) The velocity of air across the venture throat.

12) A simple jet carburetor is required to supply 6kg of air per minute and 0.45kg of fuel of density 740kg/m3.the air is initially at 1.013 bar and 27 0C

a) Calculate the throat diameter of the choke for a flow velocity of 92 m/sec. velocity coefficient =0.8

b) If the pressure drop across the fuel metering orifice is 0.75 of that at the choke, calculate the orifice diameter assuming Cd =0.6

13) The following data refer to a simple carburetor:

Throat diameter=18mm, diameter of fuel orifice =1.2mm, coefficient of air flow=0.82, coefficient of fuel flow=0.65, level petrol surface below the throat =6mm, density of air=1.2kg/m3, density of fuel=750kg/m3

Calculate:

1. The A/F ratio for a pressure drop of 0.065 bar when the nozzle tip is neglected;
2. The A/F ratio when the nozzle lip is taken into account;
3. The minimum velocity of air or critical air velocity required to start the fuel flow when nozzle lip is provided

14) An experimental four stroke gasoline engine of 1.7 liter capacity is developing maximum power at 5000 revolutions per minute. The volumetric efficiency is 75% and the air- fuel ratio 14:1. Two carburetors are to be fitted and it is expected that at maximum power the air speed at the choke is 100 m/sec. the coefficient of discharge for the venture is assumed to be 0.8 and that of the main jet is 0.65. An allowance should be made for emulsion tube, the diameter of which can be taken as 1/3 of choke diameter. The gasoline surface is 6mm below the choke at this condition. Calculate the sizes of a suitable choke and main jet. The specific gravity of gasoline is 0.75. Pa and Ta are1bar 300K respectively.

15) A petrol engine has six cylinders, diameter 7.5cm, stroke 10cm. It is single acting working on four stroke cycle and uses a volatile fuel containing 84%carbon and 16% hydrogen. The diameter at the throat of the choke tube is 38.5 mm. At 3000 r.p.m the volumetric efficiency is 0.8. The pressure at the throat of the choke tube is 0.914 bar and the temperature there is 16 0C. If the fuel-air mixture is chemically correct for combustion, estimate

a) The fuel consumption in kg/hr,

b) The speed of air through the choke

(Assume R for air and fuel as 0.287 and 0.097 kJ/kg K respectively)

16) An 8.25cm\*11.5cm, four cylinder four stroke cycle spark ignition engine is to have maximum speed of 3000 revolution/min. and volumetric efficiency of 80%. If the maximum venture depression is to be 150 cm of water. What must be the size of venture? Also determine the size of the fuel orifice if the desired air/fuel ratio equals 14:1. Take coefficient of discharge for air and fuel orifice as 0.84 and 0.7 respectively. Density of air 1.29 kg/m3 and density of fuel 700kg/m3

17) The venture of a simple carburetor has a throat diameter of 7.5cm and coefficient of air flow is 0.85. The fuel orifice has a diameter of 0.5cm and coefficient of discharge 0.7. nozzle lip is 5mm and approach factor is unity. Determine:

1. The air/fuel ratio for a pressure drop of 0.15 bar neglecting nozzle lip
2. The air fuel ratio, when the nozzle lip is taken into account.
3. The minimum velocity of air or critical air velocity required to start the fuel flow when nozzle lip is provided

(Take density of air and fuel as 1.29 and 720 kg/m3)

18) A simple jet carburetor is to supply 6.11 kg/min of air and 0.408 kg/min of petrol of density 768kg/m3. The air initially at 1 bar and 16 0C. Calculate the throat diameter of the choke if the speed of air is to be 97.5 m/sec, assuming a velocity coefficient of 0.84. Assume adiabatic expansion and ɤ for air 1.4. If the pressure at the venture is 0.8 of the pressure drop at the choke. Calculate the orifice diameter assuming a coefficient of discharge of 0.66