Name : ……………………………………………………

Roll No. : ……………………………………………………

Invigilator's Signature : …………………………………

CS/B.Tech(AUE)/SEM-4/AUE-403/2011

2011
AUTOMOTIVE PETROL ENGINE

Time Allotted : 3 Hours   *Full Marks* : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : 10 × 1 = 10

    i)   Petrol engine operates on

        a)   constant volume cycle

        b)   constant pressure cycle

        c)   dual combustion cycle

        d)   none of these.

    ii)   The approximate oil pressure in the lubrication system
          in modern cars is

        a)   40-50 kPa   b)   200-400 kPa

        c)   1-5 MPa   d)   more than 10 MPa.

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iii) Specific fuel consumption in MPFI engines is

    a) better than carbureted engine

    b) equal to that of carbureted engine

    c) cannot be compared

    d) worse than carbureted engine.

iv) Relative efficiency may be defined as

    a) air-standard efficiency to actual brake thermal efficiency

    b) actual brake thermal efficiency to air-standard efficiency

    c) indicated power to brake power

    d) brake power to indicated power.

v) Indicated thermal efficiency of a gasoline spark ignition varies from

    a) 25% to 30%   b) 70% to 75%

    c) below 10%   d) more than 75%.

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vi) The purpose of a thermostat in water cooling system is to

    a) avoid steam formation

    b) close the water passage when the engine is cold

    c) maintain the operating temperature of water

    d) prevent abnormal rise in the engine temperature.

vii) Auto ignition in a S.I. engine means

    a) automatic ignition of the charge at the end of compression

    b) ignition of the charge before the passage of the flame front

    c) ignition induced by the passage of a spark

    d) ignition induced to supplement the process of normal combustion.

viii) A spark plug gap size lies between

    a) 0·6 to 1·0 mm   b) no gap present

    c) 2·0 to 2·5 mm   d) 0·1 to 0·2 mm.

ix) The stoichiometric air to fuel ratio in an SI engine is

   a) 16 : 1   b) 14·5 : 1

   c) 12 : 1   d) 10 : 1.

x) One effect of detonation is

   a) delay in ignition

   b) interruption in lubrication

   c) loss of power

   d) deterioration in the quality of air fuel mixture.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following.   3 × 5 = 15

2. With neat sketches explain the working principle of four stroke spark-ignition engine.

3. With the help of neat valve timing diagrams, bring out the essential differences between the operation of a typical four-stroke and two-stroke petrol engines.

4. Explain with a graph the three possible theoretical scavenging process.

5. Clearly explain the various wet sump lubrication system. Compare wet sump and dry sump lubrication system.

6. Explain the phenomena of cold starting and carburetor icing with respect of fuel characteristics of a typical SI engine fuel. Your answer should be accompanied by a typical ASTM distillation curve for gasoline.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following. 3 × 15 = 45

7. a) A two stroke petrol engine having a bore of 10 cm and stroke of 14 cm runs at 2000 rpm. Compression ratio is 7. The engine develops an indicated power of 27·2 kW. The fuel-air ratio is 0·075. Exhaust pressure is 1·03 bar and intake temperature is 40°C. The indicated thermal efficiency is 0·304 and calorific value of the fuel is 44 MJ/kg. If the charge flow measured at inlet to scavenge pump is 3 kg/minute. Calculate the scavenge ratio and trapping efficiency.

   b) What are the advantages and disadvantages of air cooling ? 10 + 5

8. Describe with a neat P-θ plot, the stages of normal combustion in a typical SI engine. Indicate clearly the region susceptible to knocking on the sketch so drawn. Explain in brief the factors influencing knock in SI engines. 15
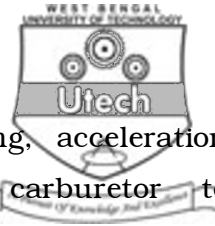
9. a) Discuss with neat sketches the idling, acceleration adjustments made to a simple carburetor to accommodate the entire A/F ratio range encountered in a typical SI engine.

   b) A four stroke petrol engine of a passenger car has a capacity of 1489 c.c. It develops maximum power at 4200 rev/min. The volumetric efficiency at this speed is 70% and the air-fuel ratio is 13 : 1. At peak power the theoretical air speed at choke is 90 m/s. The co-efficient of discharge for the venturi is 0.85 and that of the main petrol jet is 0.66. An allowance should be made for the emulsion tube, the diameter of which can be taken as 1/2.5 of the choke diameter. The Petrol surface is 6 mm below the choke at this engine condition. Calculate the sizes of a suitable choke and main jet. The specific gravity of petrol is 0.74. Atmospheric pressure and temperature are 1.013 bar and 20°C respectively. 8 + 7

10. a) Discuss the following losses in I.C. engines and their influences on *p-v* diagram :

   i) Loss due to variable specific heat

   ii) Dissociation loss

   iii) Exhaust blow down loss

   iv) Direct heat loss.

   b) State difference between a fuel air cycle and an actual cycle.

c) The initial condition for an air standard otto cycle operating with a compression ratio of 8 : 1 are 0·95 bar and 17° C. At the beginning of the compression stroke, the cylinder volume is 3·8 litre and 7·5 kJ of heat are added to the gas during the constant volume heating process. Calculate the pressure and temperature at the end of each process of the cycle and determine the thermal efficiency and mean effective pressure of the cycle. Take Cv = 0·717, γ = 1·4.   6 + 2 + 7

11. a) A four petrol engine has a bore 25 cm and stroke 45 cm. The effective diameter of the brake is 1·6 m. The observations made in a test of the engine were as follows :

Duration of test = 40 min

Total number of revolutions = 8080

Total number of explosions = 3230

Net load on the brake = 90 kg

Mean effective pressure = 5·8 bar

Volume of gas used = 7·5 m^3

Pressure of gas indicated in meter = 136 mm water of
                                                                gauge

Atmospheric temperature = 17°C

Calorific value of gas = 19 MJ/m^3 at NTP

Rise in temperature of jacket cooling water = 45°C

Cooling water supplied = 180 kg

Draw up the heat balance sheet and estimate the indicated thermal efficiency and brake thermal efficiency. Assume atmospheric pressure as 760 mm of Hg.

b) Discuss with the help of a neat sketch, the operation of a battery ignition system of a typical SI engine.   10 + 5