| BIME-010 |

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

June, 2016

00158

BIME-010 : THERMAL ENGINEERING

Time : 3 hours   *Maximum Marks : 70*

*Note : Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Use of Steam Table and Mollier Chart is permitted.*

1. (a) What do you mean by multistage compression ? State its advantages and disadvantages.

   (b) A petrol engine has the brake thermal efficiency 24% and mechanical efficiency 80%. What is its indicated thermal efficiency ?   7+7

2. (a) A two-stage, single acting reciprocating compressor takes in air at the rate of $0.2 \, \text{m}^3/\text{sec}$. Intake pressure and temperature are $0.1 \, \text{MN/m}^2$ and 16°C, respectively. The air is compressed to a final pressure of $0.7 \, \text{MN/m}^2$. The intermediate pressure is ideal and intercooling is perfect. The compression index is 1.25 and the compressor runs at 10 rev/sec. Neglect clearance.

Determine :

(i) The intermediate pressure

(ii) Total volume of each cylinder

(b) An engine uses a fuel of calorific value (CV) of 42000 kJ/kg and has a specific gravity of 0.75. The engine develops a brake power of 29.44 kW. The brake thermal efficiency of the engine is 24%. Determine the volume of the fuel consumed per second. 7+7

3. (a) Explain the difference between (i) pre-ignition, (ii) auto-ignition, and (iii) detonation.

(b) A four-stroke S.I. engine delivers a brake power of 441·6 kW with a mechanical efficiency of 85%. Determine the indicated power and frictional power of the engine. 7+7

4. (a) Explain the phenomena of knocking in S.I. engines. What are the different factors which influence the knocking ? Describe them in brief.

   (b) What do you mean by performance of an I.C. engine ? Elaborate. Discuss with a suitable sketch the brake rope dynamometer. 7+7

5. (a) State the relative advantages and disadvantages of battery and magneto-ignition systems. Describe the working of any one.

   (b) A two-stroke C.I. engine delivers a brake power of 368 kW while 73·6 kW is used to overcome the frictional losses. The engine consumes 180 kg/hr of fuel at an air-fuel ratio of 20 : 1. The heating value of fuel is 42000 kJ/kg.
   Determine the following :
   (i) Indicated power
   (ii) Mechanical efficiency
   (iii) Air consumption
   (iv) Indicated thermal efficiency
   (v) Brake thermal efficiency 7+7

6. (a) An engine is required to develop 100 kW, the mechanical efficiency of the engine is 86% and the engine uses 55 kg/hr of fuel. Due to improvement in the design and operating conditions, there is a reduction in engine friction to the extent of 4·8 kW. If the indicated thermal efficiency remains the same, determine the saving in fuel in kg/hr.

(b) A 6-cylinder petrol engine has a volume compression ratio of 5 : 1. The clearance volume of each cylinder is 0·000115 m^3. The engine consumes 10·5 kg of fuel per hour whose calorific value is 41800 kJ/kg. The engine runs at 2500 rpm, and the efficiency ratio is 0·65. Calculate the average indicated mean effective pressure developed. 7+7

7. (a) A single-cylinder four-stroke diesel engine running at 1800 rpm has a bore of 85 mm and a stroke of 110 mm. It takes 0·56 kg of air per minute and develops a brake power output of 6 kW while the air-fuel ratio is 20 : 1. The calorific value of the fuel used is 42550 kJ/kg, and the ambient air density is 1·18 kg/m^3.

Calculate :

(i) The volumetric efficiency

(ii) Brake specific fuel consumption

(b) A four-cylinder four-stroke S.I. engine has a compression ratio of 8 and bore of 100 mm, with stroke equal to the bore. The volumetric efficiency of each cylinder is equal to 75%. The engine operates at a speed of 4800 rpm with an air-fuel ratio of 15.

Given that the calorific value of fuel = 42 MJ/kg, ambient air density = $1 \cdot 12$ kg/m^3, mean effective pressure in the cylinder = 10 bar and mechanical efficiency of the engine = 80%. Determine the indicated thermal efficiency and the brake power. 7+7

8. (a) What do you understand by 'ignition timing' ? Enumerate the various factors which affect ignition timings.

(b) What are the two basic types of nozzles used in a diesel injection system ? Briefly explain them. 7+7