

**B.Tech. MECHANICAL ENGINEERING
(BTMEVI)**

Term-End Examination

December, 2012

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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*.

1. (a) What is the function of a compressor ? What are the different types of compressors ? **4+10**

(b) A 4-cylinder single stage air compressor has a bore of 200mm and a stroke of 300mm and runs at 400 rpm. At a working pressure of 620 KPa (g) it delivers 3.1 m^3 of air per min at 270°C .

Calculate :

- (i) mass flow rate.
- (ii) free air delivery (FAD)
- (iii) effective swept volume.
- (iv) volumetric efficiency ;

Take free air conditions at inlet as 101.30 KPa, 21°C .

2. (a) Define the volumetric efficiency of a compressor : On what factors it depend ? **4+10**
- (b) A single - acting two - stage reciprocating air compressor with complete intercooling delivers 6 kg/min at 15 bar pressure. Assume an intake condition of 1 bar and 15°C and that the compression and expansion processes are polytropic with $n = 1.3$.
Calculate :
(i) The power required,
(ii) The isothermal efficiency.
3. (a) Discuss the difference between ideal and actual value timing diagrams of a petrol engine. **4+10**
- (b) The following readings were taken during the test of a single - cylinder four stroke engine :
- Cylinder diameter = 250 mm
Stroke length = 400 mm
Gross m.e.p = 7 bar
Pumping m.e.p = 0.5 bar
Engine speed = 250 rpm
Net load on the brake = 1080 N.
Effective diameter of the brake = 1.5 m
Fuel used per hour = 10 kg.
Calorific value of fuel = 44300 kJ/kg

Calculate :

- (i) Indicated power
- (ii) Brake power
- (iii) Mechanical efficiency
- (iv) Indicated thermal efficiency.

4. (a) State the relative advantages and disadvantages of battery and magneto-ignition systems. **4+10**

(b) A four cylinder four - stroke SI 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 (by mass) of 15 : 1.

Given that the calorific value of fuel = 42mJ/kg, atmospheric density = 1.12 kg/m³, mean effective pressure in the cylinder = 10 bar and mechanical efficiency of the engine = 80%, determine the indicated thermal efficiency and the brake power.

5. (a) What do you mean by 'Octane number' and 'Cetane number' of fuels ? How are they determined ? **4+10**

- (b) A large four - stroke cycle diesel engine runs at 2000 rpm. The engine has a displacement of 25 litres and a brake mean effective pressure of 0.6 mN/m^2 . It consumes 0.018 kg/sec of fuel (calorific value = 42000 kJ/kg).

Determine the brake power and brake thermal efficiency.

6. (a) Discuss the mechanism of formation of exhaust emissions (CO , HC & NO_x) in petrol engines. How do these emissions vary with air - fuel ratio ? 4+10
- (b) A turbo - charged six - cylinder diesel engine has the following performance details :
- (i) Workdone during compression and expansion = 820 kW
 - (ii) Workdone during intake and exhaust = 50 kW
 - (iii) Rubbing friction in the engine = 150 kW
 - (iv) Net workdone by turbine = 40 kW .
If the brake mean effective pressure is 0.6 MPa , determine the bore and stroke of the engine taking the ratio of bore to stroke as 1 and engine speed as 1000 rpm .

7. (a) What do you mean by stoichiometric air-fuel (A/F) ratio ? 4+10
- (b) Explain the mechanism of NO_x formation and also the methods for its reduction.
8. (a) What do you understand by performance of I.C. engine ? Discuss briefly the basic performance parameters. 4+10
- (b) A single - cylinder four - stroke diesel engine running at 1800 rpm has a bore of 85 mm and 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 is 42550 kJ/kg, and the ambient air density is 1.18 kg/m³.
- Calculate :
- (i) The volumetric efficiency, and
- (ii) Brake specific fuel consumption.
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