INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022
Regulation:UG20
APPLIED THERMODYNAMICS

Time: 3 Hours   **(MECHANICAL ENGINEERING)**   **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) What is meant by ignition system? Discuss what are the requirements of an ignition system with a neat sketch.   [BL: Understand| CO: 1|Marks: 7]

   (b) Sketch the valve timing diagram for four stroke diesel engine and explain briefly. Differentiate between four stroke and two stroke diesel engine.   [BL: Understand| CO: 1|Marks: 7]

MODULE – II

2. (a) How SI and CI engine fuels rated? With the help of actual p-θ diagram briefly explain the stages of combustion in SI engine.   [BL: Understand| CO: 2|Marks: 7]

   (b) What are the requirements of a good fuel? Discuss briefly anti knock additives for a fuels.

                                                          [BL: Remember| CO: 2|Marks: 7]

MODULE – III

3. (a) Discuss the following terms: i) Specific fuel consumption ii) Brake mean effective pressure iii) Indicated power iv) Brake power v) Friction power vi) Brake thermal efficiency vii) Volumetric efficiency.   [BL: Understand| CO: 3|Marks: 7]

   (b) A four stroke, four cylinder gasoline engine has a bore of 60 mm and a stroke of 100 mm. On test it develops a torque of 66.5 N-m when running at 3000 rpm. If the clearance volume in each cylinder is 60 cc, the relative efficiency with respect to brake thermal efficiency is 0.5 and calorific value of the fuel is 42 MJ/kg. Determine the fuel consumption in kg/h and the brake mean effective pressure.   [BL: Apply| CO: 3|Marks: 7]

4. (a) Classify different methods to determine the frictional power of an I.C. engine. Discuss briefly motoring test method.   [BL: Understand| CO: 4|Marks: 7]

   (b) A six cylinder four stroke gasoline engine having a bore of 90 mm and stroke of 100 mm has a compression ratio 7. The relative efficiency is 55% when the indicated specific fuel consumption is 300 gm/ kW h. Estimate the: i) Calorific value of the fuel ii) Corresponding fuel consumption, given that indicated mean effective pressure (IMEP) is 8.5 bar and speed is 2500 rpm.

                                                               [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Describe working principle of centrifugal compressor with suitable diagram. Derive an expression for pressure coefficient for centrifugal compressor. [BL: Apply| CO: 5|Marks: 7]

   (b) A 10 stage axial flow compressor provides an overall pressure ratio of 5:1 with an overall isentropic efficiency of 87%. When the temperature of air at inlet is 15°C. The work is equally divided between the stages. A 50% reaction is used with a blade speed of 210 m/s and a constant axial velocity of 170 m/s. Estimate the blade angles. Assume a work done factor of 1.[BL: Apply| CO: 5|Marks: 7]

6. (a) With suitable sketch explain the working principle of axial flow compressor. Derive an expression for slip factor. [BL: Understand| CO: 5|Marks: 7]

   (b) A centrifugal compressor compresses 30 kg of air per second at a rotational speed of 15000 rpm. The air enters the compressor axially and the conditions at the exit sections are radius = 0.3 m, relative velocity of air at the tip = 100 m/s at an angle of 80° with respect to plane of rotation. Take p_{01}=1 bar and T_{01}=300 K. Find the torque and power required to drive the compressor and also head developed. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) What is refrigeration? List the various types of refrigeration systems. Briefly discuss the following terms: i) COP ii) Ton of refrigeration. [BL: Understand| CO: 6|Marks: 7]

   (b) Ice is formed at 0°C from water at 20°C. Temperature of brine solution is -8°C. Find out kg of ice formed per kWh. Assume the refrigeration is reversed carnot cycle. Take latent heat of ice is 335 kJ/kg. [BL: Apply| CO: 6|Marks: 7]

8. (a) Explain the effect of superheat and sub-cooling on the performance of vapour compression refrigeration cycle. [BL: Understand| CO: 6|Marks: 7]

   (b) A vapour compression refrigeration plant used R-12 and is to develop 5 tons of refrigeration. The condenser and evaporator temperature are to be 40^0C and -10^0 C respectively. Determine the: i) Refrigerant flow rate ii) Volume flow rate handled by the compressor in m^3/s iii) COP v) Power required to drive the compressor. [BL: Apply| CO: 6|Marks: 7]

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