Code No: RT22032 **R13** SET - 1

II B. Tech II Semester Supplementary Examinations, April/May - 2019
THERMAL ENGINEERING-I
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) What are the various forms of energy normally used in engine applications? Briefly explain them.
   b) Explain the method of motoring test for obtaining friction power of an engine.
   c) What do you mean by multi-stage compression? State its advantages.
   d) What are three types of blade shapes possible and how they are classified?
   e) Write short note on fuels used for gas turbines.
   f) With the aid of a neat diagram, explain the working principle of a ramjet engine.
   (3M+4M+4M+4M+4M+3M)

PART-B

2. Discuss in detail the application of various types of internal combustion engines. (16M)

3. a) Explain the basic principle and working of hydraulic dynamometer.
   b) Enumerate the advantage of gravimetric fuel flow measurement over volumetric fuel flow measurement. (8M+8M)

4. In an axial flow compressor, the overall stagnation pressure ratio achieved is 4 with overall stagnation isentropic efficiency 85 per cent. The inlet stagnation pressure and temperature are 1 bar and 300K. The mean blade speed is 180m/s. The degree of reaction is 0.5 at the mean radius with relative air angles of 12^0 and 32^0 at the rotor inlet and outlet respectively .The work done factor is 0.9. Calculate:
   i) Stagnation polytropic efficiency. ii) Number of stages.
   iii) Inlet temperature and pressure. iv) Blade height in the first stage if the hub-tip ratio is 0.42, mass flow rate 19.5 kg/s. (16M)
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5. A centrifugal compressor delivers 16.5kg/s of air with a total head pressure ratio of 4:1. The speed of the compressor is 15000r.p.m. Inlet total head temperature is 20^0C, slip factor 0.9, power input factor 1.04 and 80% isentropic efficiency. Calculate:
   i) Overall diameter of the impeller. ii) Power input. (16M)

6. Find the required air-fuel rating in a gas turbine whose turbine and compressor efficiency are 85% and 80%, respectively. Maximum cycle temperature is 875^0C .The working fluid can be taken as air (C_p=1.0kJ/kg.K,γ=1.4) which enters the compressor at 1 bar and 27^0C. The pressure ratio is 4. The fuel used has calorific value of 42000kJ/kg. There is a loss of 10% of calorific value in the combustion chamber. (16M)

7. In a jet propulsion unit air is drawn into the rotary compressor at 15^0C, 1.01 bar and delivered at 4.04 bar. The isentropic efficiency of compression is 82% and the compression is uncooled. After delivery the air is heated at constant pressure until the temperature reaches 750^0C. The air then passes through a turbine unit which drives the compressor only and has an isentropic efficiency of 78% before passing through the nozzle and expanding to atmospheric pressure of 1.01 bar with an efficiency of 88%. Neglecting any mass increase due to the weight of the fuel and assume that R and γ are unchanged by combustion, determine:
   i) The power required to drive the compressor.
   ii) The air fuel ratio if the fuel has a calorific value of 42000kJ/kg.
   iii) The pressure of the gases leaving the turbine.
   iv) The thrust per kg of air per second.
   Neglect any effect of the velocity of approach.
   Assume for air: R = 0.287kJ/kg.K , γ=1.4. (16M)