Total No. of printed pages = 4

ME 131606

Roll No. of candidate | | | | | | | | | | |

2016

B. Tech 6th Semester End-Term Examination

GAS TURBINES AND JET PROPULSION

Full Marks–100 Pass Marks–35 Time–Three hours

The figures in the margin indicate full marks for the questions.

Answer question No.1 and any *four* from the rest.

1. Answer any *ten* of the following : 10×2=20

   (i) Define heat exchanger effectiveness.

   (ii) What are the conditions to obtain best performance out of reheat cycle ?

   (iii) Define propulsive efficiency for aircraft gas turbine engine.

   (iv) Why 'specific thrust' rather than thrust is important in aircraft gas turbine engine ?

   (v) What is thermal choking ?

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(vi) Define 'Polytropic efficiency' of a compressor.

(vii) Explain why a diffuser is necessary in a centrifugal compressor.

(viii) Define 'Combustion efficiency'.

(ix) Define 'Degree of reaction'.

(x) What is 'Utilization factor' ?

(xi) What is matching of turbines and compressors ?

(xii) What are pulse jet engines ?

2. (a) Distinguish between ideal and real gas turbine cycles. 5

(b) In a gas turbine plant air enters the compressor at 1 bar and 7°C. It is compressed to 4 bar with an isentropic efficiency of 82%. The maximum temperature at the inlet to the turbine is 1073 K and the isentropic efficiency of turbine is 85%. The calorific value of the fuel used is 43100 kJ/kg. The heat losses are 15% of calorific value. Compute net power output, sfc and cycle efficiency. 5+5+5=15

3. (a) State the importance of 'Slip factor' and 'Power input factor'. Are they related ? Comment. 5

(b) A centrifugal compressor delivers 20 kg/sec of air with total head pressure ratio of 4:1. The speed of rotation is 12000 rpm. Inlet total temperature is 288 K, slip factor 0.9, power input factor 1.04 and isentropic efficiency is 80%. Calculate the overall diameter of the impeller. Also obtain the power input in kW. 10+5=15

4. (a) What are the processes taking place inside a combustion chamber of a gas turbine engine ? 5

(b) Discuss the various losses that may occur in the combustion chamber of a gas turbine engine. 5

(c) With neat sketch explain the working of a Ramjet engine. 5+5=10

5. (a) Draw a neat curve to explain the working of an axial flow compressor. 5+5=10

(b) An axial flow compressor of 50% reaction design has blades with inlet and outlet angles of 45° and 10° respectively. The compressor is to produce pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when

inlet static temperature is 300 K. The blade speed and axial velocity are constant throughout the machine. Assuming a value of 200 m/s for the blade speed, find the number of stages required if the work done factor is 0.87. 10

6. (a) Derive a relation between degree of reaction, flow coefficient and blade angles for an axial flow turbine. Explain the implications of 50% reaction design. 5+5=10

(b) In a gas turbine plant, air enters the compressor at 1 bar and 27 deg.C. The pressure ratio is 6. The temperature at turbine inlet is 1000 K. The mass flow rate of air is 10 kg/sec. Determine :

(i) Power required to drive the compressor

(ii) Net power developed by the plant and

(iii) Cycle efficiency. 5+3+2=10

7. (a) Explain the mechanism of NO_x formation in gas turbine engines. 5

(b) What is noise ? What are the sources of noise in gas turbine engines ? Explain briefly some methods of noise reduction. 2+6+7=15