**UNIVERSITY OF PETROLEUM
AND ENERGY STUDIES
End Semester Examination, April, 2017**

UPES
THE NATION BUILDERS UNIVERSITY

Program/course: B. Tech PSE   **Semester – viii**
Subject: DIESEL & GAS TURBINE PLANT   **Max. Marks : 100**
Code : PSEG-335   **Duration   : 3 Hrs**
No. of page/s:2

Section A: 4 marks each (Attempt all questions)

1. Describe the thermodynamic cycle of gas power plant with the help of T-S diagram.
2. With a neat sketch explain centrifugal compressor.
3. Explain the working of evaporative cooling system.
4. Discuss stage pressure and velocity variation in axial flow compressor.
5. Define Waste Heat Recovery Boiler.

Section B: 10 marks each (Q 6-8 are MANDATORY, attempt any ONE PART of Q 9)

6. Discuss Mist lubrication system with neat sketch.
7. Prove that the overall efficiency of combined gas and steam cycle plant is given by(abbreviations : gt-gas turbine, st-steam turbine.)

    $\eta_o = \eta_{gt} + \eta_{st} - \eta_{gt} {}^* \eta_{st}$

8. A combined gas and steam plant develops 10 MW at the gas turbine shaft with an efficiency of 20%. A steam turbine power plant ($\eta_{st} = 32\%$) is operated through the WHRB which receives the turbine exhaust. calculate
    a. Output of steam turbine plant
    b. Thermal efficiency of combined cycle plant.
    c. Overall heat rate.

9. A closed cycle regenerative gas turbine operating with air as the working medium. Assume the following data: inlet air pressure and temperature to the compressor is 1.4 bar and 310 K. The maximum temperature of cycle is 1050 °K. Pressure at outlet of compressor is 5 bar. Effectiveness of regenerator is 100 ‰net output is 3000 W. Assuming the compression and expansion to be isentropic ($C_p = 1.005 \frac{KJ}{Kg.k}, \Upsilon = 1.4$). calculate
    A) Thermal efficiency.
    B) Mass flow rate of air per minute

                    Or
        Explain open and closed circuit gas power plant with schematic diagram.

Section C: 20 marks each

10. Describe with aid of an illustrative sketch of a combined gas and steam turbine power plant

11. Explain various methods employed for improving the efficiency and output of a constant pressure Gas Turbine Plant .

or

A Brayton cycle works b/w 1 bar, 300 K and 5 bar,1250 K. there are 2 stages of compression with perfect intercooling and 2 stages of expansion. The work o/p of 1st expansion stage being used to drive two compressors, where the interstage pressure is optimized for the compressor. The air from 1st stage turbine is again heated to 1250 K and expanded. Calculate power output of free power turbine and cycle efficiency.($C_p = 1.005 \frac{KJ}{Kg.k}, \Upsilon = 1.4$)

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Section A: 4 marks each (Attempt all questions)

1. With neat sketch explain the working of closed cycle gas power plant.
2. Briefly discuss the applications of gas turbine.
3. Differentiate b/w Impulse and Reaction Turbine.
4. Describe individual pump and nozzle fuel injection system .
5. Discuss Thermosyphon System w.r.t to diesel power plant.

Section B: 10 marks each (Q 6-8 are MANDATORY, attempt any ONE PART of Q 9)

6. Derive the expression of efficiency of Gas Turbine plant. State assumptions also.
7. Explain the working of combined steam and gas turbine power plant.
8. A gas turbine operates on a pressure ratio of 6.The inlet air temperature to the compressor is 300 K and air entering the turbine is at a temperature of 577°c. if volume rate of air entering the compressor is 240 m^3/s. calculate the net power o/p of the cycle in MW. Also compute its efficiency .assume that the cycle operates under ideal conditions($C_p = 1.005 \frac{KJ}{Kg.k}, Y = 1.4$).

9. A combined gas and steam plant develops 15 MW at the gas turbine shaft with an efficiency of 25%. A steam turbine power plant ($\eta_{st} = 30\%$) is operated through the WHRB which receives the turbine exhaust. calculate
   d. Output of steam turbine plant
   e. Thermal efficiency of combined cycle plant.
   f. Overall heat rate.

Or

Derive the relation of turbine and compressor efficiency for an actual Gas Turbine cycle with respect to ideal cycle.

10. Draw the schematic diagram of a simple cycle with intercooled, heat exchanged and reheat and explain briefly the working principle. Draw also T-S diagram of cycle.

11. In a closed cycle gas turbine, there is two stage compressor and two stage turbine. All the components are mounted on same shaft. The pressure and temperature of first stage compressor are 1.5 bar, 20° C. The maximum cycle temperature and pressure are limited to 750˚c and 6 bar. A perfect intercooler is used between two stage compressor and a reheater is used between two turbines. Gases are heated in reheater to 750˚C before entering into L.P turbine. Assuming the compression and expansion to be isentropic .calculate

    a) The efficiency of cycle without regenerator.
    b) The efficiency of cycle with regenerator whose effectiveness is 0.7.
    c) Mass of working fluid circulated, if power developed by the plant is 300 KW

Or

Discuss the four main components of a gas power plant , describing each of them in details.