

Code No: RR310303

RR

Set No. 2

III B.Tech I Semester Examinations, November 2010

THERMAL ENGINEERING - II

Mechanical Engineering

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions

All Questions carry equal marks

- State the differences between the following boilers:
 - Externally fired and internally fired.
 - Forced circulation and Natural circulation
 - High Pressure and Low pressure
 - Stationery and mobile. [4×4]
- An open cycle gas turbine plant has a single stage compressor and a single stage expander incorporating a heat exchanger. The air suction temperature is 17°C and the pressure 1 bar. For an over all pressure ratio of 4.5 and shaft output of 4000kW, The mass flow is 40kg/s. If the thermal of heat exchanger is 0.6 and the isentropic efficiency of compressor is 0.84, calculate the isentropic efficiency of the gas turbine for a plant thermal efficiency of 0.29. take $\gamma = 1.4$, $C_{pg} = 1.07 \text{ kJ/kg}$. [16]
- Sketch a combined velocity diagram with reference to steam turbines. Name and mark all angles and velocities on it.
 - In a stage of impulse reaction turbine operating with 50% degree of reaction, the blades are identical in shape. The outlet angle of the moving blades is 19° and the absolute discharge velocity of steam is 100m/s in the direction at 100° to the motion of the blades. If the rate of flow of steam through the turbine is 15000 kg/hr, calculate the power developed by the turbine in kW. [8+8]
- The air leakage into a surface condenser operating with a steam turbine is estimated as 84 Kg/hr. The vacuum near the inlet of air pump is 700 mm of Hg. When Barometer reads 760 mm of Hg. The temp. at the inlet of vacuum pump is 20°C. Calculate
 - Min. capacity of air pump in m³/hr.
 - The dimensions of the reciprocating air pump to remove the air if it run at 200 RPM and L/D ratio=1.5 and volumetric efficiency =100%.
 - The mass of vapour extracted per minute. [16]
- The outlet area of a nozzle in a simple impulse turbine is 15 cm² and the steam leaves the nozzles at 14 N/cm², 0.9 dry with a velocity 650 m/s. The nozzle is inclined at 20° to the plane of the wheel, the blade speed is 250 m/sec, the blade exit angle is 30° and the blade velocity coefficient is 0.8. Estimate the power developed and specific steam consumption. [16]

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6. Discuss the theory of the rocket engine. [16]
7. (a) Explain with a neat sketch the working of a ram jet engine.
(b) What do meant by semi-cryogenic nature of a propellant? List the different propellants used in a rocket engine. [8+8]
8. Steam expands in a nozzle under the following conditions: inlet pressure = 15 bar; inlet temperature = 250°C ; Final pressure = 4 bar; mass flow rate = 1 kg/s. Calculate the required throat and exit areas, using Mollier diagram, when
- (a) the expansion is frictionless and
(b) the friction loss is 10% of the total heat drop. [16]

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Mechanical Engineering

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1. State the differences between the following boilers:
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 - (c) High Pressure and Low pressure
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2. An open cycle gas turbine plant has a single stage compressor and a single stage expander incorporating a heat exchanger. The air suction temperature is 17°C and the pressure 1 bar. For an over all pressure ratio of 4.5 and shaft output of 4000kW, The mass flow is 40kg/s. If the thermal ratio of heat exchanger is 0.6 and the isentropic efficiency of compressor is 0.84, calculate the isentropic efficiency of the gas turbine for a plant thermal efficiency of 0.29. take $\gamma = 1.4$, $C_{pg} = 1.07 \text{ kJ/kg}$. [16]
3. The air leakage into a surface condenser operating with a steam turbine is estimated as 84 Kg/hr. The vacuum near the inlet of air pump is 700 mm of Hg. When Barometer reads 760 mm of Hg. The temp. at the inlet of vacuum pump is 20°C . Calculate
 - (a) Min. capacity of air pump in m^3/hr .
 - (b) The dimensions of the reciprocating air pump to remove the air if it run at 200 RPM and L/D ratio=1.5 and volumetric efficiency =100%.
 - (c) The mass of vapour extracted per minute. [16]
4. Discuss the theory of the rocket engine. [16]
5. The outlet area of a nozzle in a simple impulse turbine is 15 cm^2 and the steam leaves the nozzles at 14 N/cm^2 , 0.9 dry with a velocity 650 m/s. The nozzle is inclined at 20° to the plane of the wheel, the blade speed is 250 m/sec, the blade exit angle is 30° and the blade velocity coefficient is 0.8. Estimate the power developed and specific steam consumption. [16]
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- (b) the friction loss is 10% of the total heat drop. [16]
7. (a) Explain with a neat sketch the working of a ram jet engine.
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8. (a) Sketch a combined velocity diagram with reference to steam turbines. Name and mark all angles and velocities on it.
- (b) In a stage of impulse reaction turbine operating with 50% degree of reaction, the blades are identical in shape. The outlet angle of the moving blades is 19° and the absolute discharge velocity of steam is 100m/s in the direction at 100° to the motion of the blades. If the rate of flow of steam through the turbine is 15000 kg/hr, calculate the power developed by the turbine in kW. [8+8]

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Mechanical Engineering

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 - (a) Min. capacity of air pump in m^3/hr .
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