Roll No. .....

24173

B. Tech 4th Semester (Mechanical Engg.)

Examination – May, 2013

STEAM & POWER GENERATION

Paper : ME-210-F

Time : Three hours] *[Maximum Marks : 100*

Before answering the question, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt any ***five*** questions in total by selecting at least ***one*** question from each Section. Question No. **1** is ***compulsory***. Use of steam tables is allowed.

1. (i) What is the reason that the carnot cycle is not a practical cycle for steam turbine plant even though its efficiency is higher ?

(ii) What do you mean by critical temperature and pressure of water ?

(iii) Why is blow down needed in boilers ?

(iv) Why is expansion of steam in nozzle not a throttling process ?

(v) What is a compressible fluid ?

(vi) What are stagnation temperature and stagnation pressure ?

(vii) How does air leakage affect the condenser performance ?

(viii) What are the main constituents of fuel oil ?

$8 \times 2.5 = 20$

SECTION – A

2. (a) Draw p-v, h-s and T-s diagrams for modified Rankine cycle. 8

(b) A steam turbine plant is supplied with steam at pressure 17 bar and superheated to 100°C. The exhaust pressure is 0.06 bar. The temperature of condensate in the hot well is actually 33°C (specific volume = 0.001 m^3/kg). Find thermal efficiency of plant. 12

3. (a) Explain in detail the mountings of steam generators. 10

(b) Determine the height of chimney required in a boiler having natural draught equivalent to 20 mm of water. The flues gase are at temperature of 300°C, atmospheric air temperature is 27°C and 18 kg air per kg of fuel is required in boiler. 10

SECTION – B

4. (a) Derive an expression for mass low rate of steam flowing through a nozzle under a pressure drop from p_1 to p_2. 10

(b) Steam is expanded in a set of nozzles from 10 bar and 200°C to 5 bar. Is the nozzle convergent or divergent ? Neglecting the initial velocity, find the minimum area of the nozzle to flow 3 kg/s of steam under given conditions. 10

5. (a) Describe various types of compounding in steam engines and their relative merits and demerits. 10

(b) A double acting steam engine has bore of 30 cm and stroke to bore ratio of 2 with cut-off occurring at 40% of stroke. Steam enters the engine cylinder at 7.5 bar and exhausts at 0.1 bar. Engine runs at 180 r.p.m. Neglecting clearance volume and considering diagram factor of 0.6 determine the indicated horse power. 10

SECTION – C

6. The velocity of steam entering a simple impulse turbine is 1000 m/s and the nozzle angle is 20°. The mean peripheral velocity of blades is 400 m/s and blades are symmetrical. If the steam is to enter the blades without shock, what will be the blade angles ?
(i) Neglecting the friction effects on blades, calculate the tangential force on the blades and diagram power for a mass flow of 0.75 kg/s. Estimate also the axial thrust and diagram efficiency.

If the relative velocity at exit is reduced by friction to 80% of that at inlet, estimate axial thrust, diagram power and diagram efficiency. 20

7. (a) What are back pressure turbine and pass out turbine? When these are used ? 10

(b) Obtain the condition for maximum diagram efficiency of a reaction turbine in terms of absolute angle at inlet to moving blade. 10

SECTION-D

8. (a) Differentiate between jet and surface condenser. 5

(b) In a condenser the vacuum of 71 cm of Hg is maintained with barometer reading of 76 cm in Hg. Temperature in condenser is 35°C while hot well is at temperature of 30°C. The cooling water is circulated at the rate of 800 kg/min and condenser is available at 25 kg/min. The temperature of cooling water at inlet and outlet are 15°C and 25°C. Determine the mass of air in kg/min^3 of condenser volume. Dryness fraction of steam entering condenser is and vacuum efficiency. Take mercury density as 0.0135951 kg/cm^3, $g = 9.81\ m/s^2$. 15

9. (a) Coal having following composition by mass is burnt with theoretically correct amount of air. 86 % C, 6%H, 5% O, 2% N, 1% S. Determine the air-fuel ratio. 10

(b) Explain working of Orsat analyzer for flue gas analysis. 10