KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Marks Scored:

Level: B. E.
Year : IV

Course : MEEG 441
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 08 MAR 2019

SECTION "A"
[20 Q. × 1 = 20 marks]

Select and mark [X] for the most appropriate answer.

1. Which processes do occur in the Brayton cycle?
   [ ] two reversible adiabatic processes and two reversible isochoric processes
   [ ] two reversible adiabatic processes and two reversible isobaric processes
   [ ] two reversible adiabatic processes and two reversible isothermal processes
   [ ] two reversible adiabatic processes and two reversible isentropic processes

2. Which processes do the Rankine cycle contain?
   [ ] two isothermal and two isochoric processes
   [ ] two isentropic and two isobaric processes
   [ ] two isentropic and two isothermal processes
   [ ] two isothermal and two isobaric processes

3. The feed water heater in which the extracted steam and feed water have thermal contact for exchanging heat but the extracted steam is not allowed to mix with the feed water is called as
   [ ] open type feed water heater
   [ ] contact type feed water heater
   [ ] closed type feed water heater
   [ ] mix type feed water heater

4. When two vapor cycles are coupled in series and heat rejected by one is absorbed by another, the cycle is called as
   [ ] dual vapour cycle
   [ ] binary vapour cycle
   [ ] coupled vapour cycle
   [ ] combined vapour cycle

5. The nozzle efficiency can be defined as the ratio of
   [ ] isentropic enthalpy drop to actual enthalpy drop
   [ ] actual enthalpy drop to isentropic enthalpy drop
   [ ] isothermal enthalpy drop to isentropic enthalpy drop
   [ ] isentropic enthalpy drop to isothermal enthalpy drop

6. The quality of vapour at the exit of nozzle _____ due to nozzle friction.
   [ ] increases
   [ ] decreases
   [ ] does not change
   [ ] unpredictable

7. In case of reaction steam turbine
   [ ] there is enthalpy drop only in moving blades
   [ ] there is enthalpy drop only in fixed blades
   [ ] there is enthalpy drop both in fixed and moving blades
   [ ] there is no enthalpy drop in blades

8. The degree of reaction is _____ for Parson's reaction steam turbine.
   [ ] 50 %
   [ ] 100 %
   [ ] 60 %
   [ ] 75 %

9. Which of the following is a steam turbine?
[ ] De laval [ ] Kaplan [ ] Francis [ ] Bulb

10. Degree of reaction is given by
[ ] heat drop in moving blades / total heat drop in the stage
[ ] heat drop in fixed blades / total heat drop in the stage
[ ] heat drop in moving blades / heat drop in fixed blades
[ ] total heat drop in the stage / heat drop in fixed blades

11. For a jet-propulsion unit, ideally the compressor work and turbine work are
[ ] equal [ ] unequal
[ ] not related to each other [ ] unpredictable

12. A gas turbine works on which cycle?
[ ] Carnot [ ] Brayton [ ] Dual cycle [ ] Rankine cycle

13. A jet engine works on the principle of
[ ] conservation of mass [ ] conservation of energy
[ ] conservation of momentum [ ] conservation of discharge

14. In turbofan engine, the bypass ratio is the ratio of
[ ] total mass flow rate of exhaust stream to the mass flow rate of stream from turbine exhaust
[ ] total mass flow rate of exhaust stream to the mass flow rate of stream from fan exhaust
[ ] the mass flow rate of stream from turbine exhaust to the mass flow rate of stream from fan exhaust
[ ] the mass flow rate of stream from fan exhaust to the mass flow rate of stream from turbine exhaust

15. What is the main source for the formation of Wind?
[ ] uneven land [ ] sun [ ] vegetation [ ] seasons

16. The amount of energy available in the wind at any instant is proportional to _____ of the wind speed.
[ ] square root power of two [ ] square root power of three
[ ] square power [ ] cube power

17. Calculate the air density, when 10 m/s wind is at 1 STD atmospheric pressure and 15 ^{0}C?
[ ] 1.226 kg/m^3 [ ] 1.033 kg/m^3 [ ] 2.108 kg/m^3 [ ] 0.922 kg/m^3

18. Which of the following is NOT a type of positive displacement pumps?
[ ] reciprocating pump [ ] rotary displacement pump
[ ] centrifugal pump [ ] none of the mentioned

19. The ratio of actual whirl velocity to the ideal whirl velocity in the centrifugal compressor is called as
[ ] velocity factor [ ] slip factor [ ] work factor [ ] momentum factor

20. The choice of fan type for a given application depends on
[ ] flow [ ] static pressure [ ] both a & b [ ] neither (a) nor (b)

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F. M. : 55

SECTION "B"

Attempt *ALL* questions. Assume suitable data if missing/necessary. **Students are allowed to use Steam Table and Mollier Diagram**.

Q.N.1.

a. Discuss in brief the fundamental laws dealing with the problems of design and operation of turbo machines. [4]

b. Air leaves a heat exchanger and enters a turbine at a temperature of 800 ^{0}C and at a speed of 30 m/s. The temperature of the air at the exit of turbine is 650 ^{0}C and at a speed of 60 m/s. Mass flow rate of air is 2 kg/s. Calculate the power output from the turbine assuming no heat transfer. [4]

Q.N. 2.

a. Describe in brief, the major components of gas turbine engine. [4]

b. Air enters the compressor of a regenerative gas turbine engine at 310 K and 100 KPa, where it is compressed to 900 KPa and 650 K. The regenerator has an effectiveness of 80 percent, and the air enters the turbine at 1400 K. For a turbine efficiency of 90 percent, determine (a) the amount of heat transfer in the regenerator and (b) the thermal efficiency. Use constant specific heats at room temperature. [5]

Q.N. 3.

a. Explain with a neat diagram the working of the ideal reheat Rankine cycle. Support your answer with the help of T – s diagram. [4]

b. During a regeneration process, some steam is extracted from the turbine and is used to heat the liquid water leaving the pump. This does not seem like a smart thing to do since the extracted steam could produce some more work in the turbine. How do you justify this action? [3]

Q.N. 4.

a. Show that there is only one value of the ratio (called critical pressure ratio) p_2/p_1 which will produce the maximum discharge through the nozzle and find its value for the maximum discharge. [4]

b. In a steam nozzle, the steam expands from 4 bar to 1 bar. The initial velocity is 55 m/s and initial temperature is 200 ^{0}C. Determine the exit velocity if the nozzle efficiency is 91 %. [5]

Q.N. 5.

a. Describe the difference between an impulse turbine and a reaction turbine. [3]

b. Define compounding. List different types of compounding. Explain any one method of compounding with neat sketch showing variations of pressure and velocity of steam. [4]

c. In a De Laval turbine, steam issues from the nozzles with velocity of 1250 m/s. the nozzle angle is 20^0 and the mean blade velocity is 400 m/s and inlet and the outlet angles of the blades are equal. The mass of steam flowing through the turbine per hour is 1000 kg. Calculate: (a) blade angle (b) relative velocity of steam entering the blades (c) tangent force on the blades (d) power developed, and (e) blade efficiency. Take blade velocity coefficient as 0.8. [6]

Q.N. 6.

a. How is wind generated? Explain in brief the variation in wind speed and direction. [3]

b. Find the size of wind turbine rotor (diameter in m) that will generate 200 kW of electrical power in a steady wind (hub height) of 8.5 m/s. Assume that the air density is $\rho = 1.225$ kg/m^3. [3]

Q.N. 7.

Give major classifications of pumps and the basic principle of centrifugal pump working. [3]

OR

Discuss about the main factors to be considered for proper sizing of fans. [3]