



RM-6507

B. E. - II (Sem. IV) (Electrical Engg.) Examination
May / June - 2010
Applied Thermodynamics & Thermal Engg.

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दृष्टावेक निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
B. E. - 2 (Sem. 4) (Electrical Engg.)	<input type="text"/>
Name of the Subject :	<input type="text"/>
Applied Thermodynamics & Thermal Engg.	<input type="text"/>
Subject Code No. : <input type="text"/> 6 <input type="text"/> 5 <input type="text"/> 0 <input type="text"/> 7	Section No. (1, 2,...): <input type="text"/> 1&2
	Student's Signature

- (2) Attempt **all** questions from both sections.
- (3) Answer of the **two** sections must be written in **separate** answer books.
- (4) Figures to the right indicate full marks.
- (5) Use of non programmable calculator, Molier charts, steam table and heat transfer data table if required is permitted.
- (6) Assume suitable data if required.

SECTION - I

- 1 (a) Fill up the correct answer in the blank. 5
- (i) _____ is an extensive property of a system.
(pressure, volume, temperature)
 - (ii) The Clausius inequality statement is _____.
$$\left(\oint \frac{dQ}{T} \leq 0, \oint \frac{dQ}{T} \geq 0, \oint \frac{dQ}{T} = 0 \right)$$
 - (iii) The operating cost of water tube boiler is _____
than fire tube boiler. (lower, equal, higher)

- (iv) The critical pressure ratio for initially superheated steam is _____ as compared to initially dry saturated steam. (less, more, equal)
- (v) The gas turbine cycle with intercooling decreases_____. (compressor input, work ratio, avoids pollution).

(b) Match the correct combination. 5

Match A	Match B
(i) First law of thermodynamics	(a) Chemical composition
(ii) Internal energy	(b) Cross area decreases
(iii) Convergent nozzle	(c) Lo-effler boiler
(iv) High pressure boiler	(d) Increasing thermal efficiency
(v) Gas turbine with regeneration	(e) Cochran boiler
	(f) Law of conservation of energy

(c) (i) Explain clausius statement. 3

(ii) The pressure and volume relation during a 7

non-flow reversible process is given by $P = \left(v^2 + \frac{8}{v} \right)$

bar.

The volume changes from $V_1 = 8 \text{ m}^3$ and $V_2 = 2 \text{ m}^3$. Calculate the work done. The heat rejected during the process is 200 kJ. Determine the change in internal energy.

OR

- (c) (i) What is Intensive property and Extensive property? 2
- (ii) A Carnot heat engine, absorbs 1000 kJ of heat per minute from a higher temperature reservoir which rejects certain amount of heat to a low temperature reservoir and in doing so, it produces 5 kW of power. If the temperature of high temperature reservoir is 100°C, what will be the temperature of low temperature reservoir? 8
- 2** (a) Derive an expression to obtain mass of steam discharge through a nozzle. 8
- (b) A nozzle expands steam from 14 bar and 300°C to 6 bar, if the flow rate is 1 kg/s. Find the throat area of the nozzle. 7
- OR**
- 2** (a) What is nozzle? Explain different types of nozzles. 5
- (b) Steam at the rate of 7.5 kg/s flows through a set of nozzles. The inlet pressure is 14 bar and superheat is 55°C. The exit pressure is 6 bar. Neglect the velocity of approach and assume the expansion of steam is isentropic. Find the number of nozzles used if the outlet area of each nozzle is approximately 2.3 cm². What should be the correct exit area? 10
- 3** (a) Explain with neat sketch of working of la-Mont boiler. 8
- (b) Derive an expression of thermal efficiency of a brayton cycle of gas turbine. 7
- OR**
- (b) Explain in detail about methods of improving the efficiency and the specific output of simple gas turbine cycle. 7

SECTION - II

- 4 (a) Answer the following questions :
- (i) In a 4 stroke engine, the camshaft is connected to the crankshaft by gears and rotates at
 - (a) half the crankshaft speed
 - (b) three-fourth the cranksheet speed
 - (c) equal the crankshaft speed
 - (d) double the crankshaft speed.
 - (ii) Stoichiometric (chemically correct) air fuel ratio for IC engine fuels is about
 - (a) 10.5
 - (b) 14.5
 - (c) 16.8
 - (d) 18.5
 - (iii) In a four stroke diesel engine during suction stroke
 - (a) only air is sucked in
 - (b) only fuel is sucked in
 - (c) mixture of fuel and air is sucked in
 - (d) none of above
 - (iv) Most of the mopeds in India have a capacity of
 - (a) 50 cc
 - (b) 150 cc
 - (c) 200 cc
 - (d) 250 cc
 - (v) De-Laval turbine is
 - (a) pressure compounded impulse turbine
 - (b) velocity compounded impulse turbine
 - (c) single simple wheel impulse turbine
 - (d) single simple wheel reaction turbine

- (vi) For parson's reaction steam turbine, degree of rection is
 - (a) 75%
 - (b) 100%
 - (c) 50%
 - (d) 60%
- (vii) In regenerative feed heating vapour extracted or bled from the turbine is used for
 - (a) preheating of air
 - (b) preheating of fuel
 - (c) heating feed water being supplied to boiler
 - (d) reheating steam to
- (viii) Heat transfer takes place according to
 - (a) zeroth law of thermodynamics
 - (b) first law of thermodynamics
 - (c) second law of thermodynamics
 - (d) Kirchoff's law
- (ix) The heat of sun reaches to us according to
 - (a) conduction
 - (b) convection
 - (c) radiation
- (x) Heat transfer from hot body to cold body is directly proportional to the surface area and difference of temperature between two bodies. This statement is called
 - (a) first law of thermodynamics
 - (b) Newton's law of cooling
 - (c) Newton's law of heating
 - (d) Stefan's law

- (b) With a neat sketch explain actual valve timing diagram for 4 stroke otto cycle engine.

8

5 Attempt any two :

16

- (a) Following observations were recorded during a test on a single cylinder oil engine :

Bore = 300 mm, stroke = 450 mm, speed = 300 rpm,
i.m.e.p. = 6 bar, net brake load = 1.5 kN, brake drum
diameter = 1.8 m, brake rope diameter = 2 cm.
Calculate

- (i) Indicated power
 - (ii) Brake power and
 - (iii) Mechanical efficiency.
- (b) Explain why compounding of steam turbine is required.
Explain velocity compounding of impulse turbine.
- (c) Explain throttle governing of steam turbines.
- (d) In a De Laval turbine steam issues from the nozzle with a velocity of 1200 m/s. The nozzle angle is 20° , the mean blade velocity is 400 m/s, and the inlet and outlet angles of blades are equal. The mass of steam flowing through the turbine per hour is 1000 kg. Calculate :
- (i) Blade angles
 - (ii) Relative velocity of steam entering the blades
 - (iii) Tangential force on the blades
 - (iv) Power developed
 - (v) Blade efficiency

Take blade velocity coefficient as 0.8.

- 6 (a) Derive an expression for critical thickness of insulation for cylinders and explain the importance of it.

8

- (b) Define the following dimensionless numbers and explain its significance 8
- (i) Nusselt number
 - (ii) Prandtl number
 - (iii) Reynold's number

OR

- 6** (a) Explain the following terms : **6**
- (i) Gray body
 - (ii) Black body
 - (iii) Total emissive power
 - (iv) Emissivity
 - (v) Reflectivity
 - (vi) Specular reflection
- (b) Derive an equation for heat transfer by conduction through a composite cylinder. 8
- (c) State Stefan's law of radiation. 2
-