Code No: R05220304 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2008
THERMAL ENGINEERING-I
(Common to Mechanical Engineering and Automobile Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Illustrate the constructional details of an I.C engines? Explain briefly about important components?
   (b) How do you classify I.C. Engines? Explain in detail. [8+8]

2. (a) Explain the effect of different operating parameters on flame propagation velocity.
   (b) What are the different required characteristics of a good combustion chamber for S.I.Engine? Explain. [8+8]

3. (a) What are different fuel injectors used in C.I. Engines? Explain briefly.
   (b) Draw p - θ diagram and explain different stages of combustion in C.I. Engines. [8+8]

4. (a) Explain the details of the analytical method of performance estimation.
   (b) A four-stroke cycle automobile engine is tested while running at 3600 rpm. Inlet air temperature is 16^0C and the pressure is 101.36 kN/m^2. The engine has eight in-line cylinders with a total piston displacement of 4066 cc. The air fuel ratio is 14 and the bsfc is 0.377 kg/kWh. Dynamometer readings show a power output of 86 kW. Find the volumetric efficiency. [6+10]

5. The average indicator and information taken from a 25 × 35 cm, single cylinder, double- acting reciprocating air compressor operating at 80 r.p.m. is
   Head end area = 11.1 cm^2, Crank end area = 12.9 cm^2, Length = 7.5 cm, Spring scale = 2.5 bar per cm of deflection. Account for the 5 cm dia piston rod and find
   (a) then mean effective pressure and the indicated power for each end ;
   (b) the total indicated power : [16]

6. A centrifugal compressor has an impeller tip speed of 366 m/s. Calculate the absolute Mach Number of the flow leaving the radial vanes of the impeller when the radial component of velocity at impeller exit is 30.5 m/s and slip factor is 0.90. Given that the mass flow area at impeller exit is 0.1 m^2 and the total efficiency of the impeller is 90%, determine the mass flow rate. [16]

7. (a) What are the advantages of using a flash chamber in parallel with evaporator? Show that the use of flash chamber has no effect on the thermodynamics of the cycle and Power required by the system in ideal condition.

(b) A compressor 10 cm × 10 cm single acting twin cylinder, 900 r.p.m. is working on F-12 with condensing temperature of 38^0C and evaporator temperature of 4^0C. Compression is isentropic and vapour is just dry and saturated at the end of compression. Calculate.

i. The capacity of the refrigerator.

ii. Power required to run the compressor if the volumetric efficiency of the compressor is 85%.

iii. C.O.P. of the system. [16]

8. A sample of air is having DBT 21^0C and RH 30% at barometric pressure 760 mm or mercury. Find

(a) Partial pressure of vapour ;

(b) Specific humidity ;

(c) WBT ;

(d) Percentage humidity or degree of saturation ;

(e) Specific volume of dry air ;

(f) DPT ;

(g) Enthalpy of moist air per kg of dry air.

Given R = 0.287 kJ / kg K, C_p (dry air) = 1.005 kJ/kg K and Specific heat of superheated vapour = 1.884 kJ/kg K Latent heat of vaporization at DPT = 2493 kJ/kg Do not use psychrometric chart. Psychrometric table can be used. [16]

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Code No: R05220304 **Set No. 2**

II B.Tech II Semester Regular Examinations, Apr/May 2008
THERMAL ENGINEERING-I
(Common to Mechanical Engineering and Automobile Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Illustrate the constructional details of an I.C engines? Explain briefly about important components?
   (b) How do you classify I.C. Engines? Explain in detail. [8+8]

2. (a) Explain the phenomenon of flame propagation in S.I. Engine combustion.
   (b) How the mixture strength influence rate of burning and flame propagation speed? [8+8]

3. (a) Explain the influence of different operating parameters on ignition delay during combustion process in C.I. Engine.
   (b) Describe the phenomenon of knocking in C.I. Engine and how it is different from S.I. Engine detonation. [8+8]

4. A six-cylinder four-stroke, direct-injection oil engine is to deliver 120 kW at 1600 rpm. The fuel to be used has a calorific value of 43 MJ/kg and its percentage composition by mass is carbon 86% , hydrogen 13% , and non combustibles 1% . The absolute volumetric efficiency is assumed to 80% , the indicated thermal efficiency 40% and the mechanical efficiency 80% . The air consumption to be 110% in excess of that required for theoretically correct combustion.
   (a) Estimate the volumetric composition of dry exhaust gas
   (b) Determine the bore and stroke of the engine, taking a stroke to bore ratio as 1.5.
   Assume the volume of 1 kg of air at the given conditions as 0.77 m^3. [16]

5. A single acting air compressor draws in 5 m^3 / min of air at 1 bar and 20^0C and delivers it at 8 bar. The compression follows the law $pV^{1.35} = C$. Neglect clearance. Compare the indicated power required if the following methods are adopted.
   (a) Single stage compression.
   (b) Two stage compression with best intercooler pressure and perfect intercooling.
   (c) Two stage compression with the same intercooler pressure as in (b) but the cooling is not perfect and the temperature of intercooled air can be brought to 25^0 C.
   (d) Three stage compression with perfect intercooling.
   Assume R = 287 J / kg K. [16]

6. Air at a temperature of 290 K enters a ten stage axial flow compressor, at the rate of 3.0 kg/s. The pressure ratio is 6.5 and the isentropic efficiency is 90 per cent, the compression process being adiabatic. The compressor has symmetrical stages. The axial velocity of 110 m/s is uniform across the stage and the mean blade speed of each stage is 180 m/s. Determine the direction of the air at entry to and exit from the rotor and the stator blades and also the power given to the air. C_p = 1.005 KJ/kg K and γ = 1.4. [16]

7. (a) What are advantages of cascading?
   (b) The speed of a aircraft flying at an altitude of 8000m, where the ambient air is at 0.341 bar pressure and 263 K temperature, is 900 km/h The compression ratio of the air compressor is 5. The cabin pressure is 1.01325 bars and the temperature is 27^0C. Determine the power requirement of the aircraft for pressurization (excluding the ram Work), additional power required for refrigeration and refrigerating capacity for simple Aircraft refrigeration cycle on the basis of 1 kg/s flow of air. Specific heat of air = 1.005 kJ/kg K and C_p/C_v = 1.4. [16]

8. An air-conditioned space is maintained at 27^0C DBT and 50 percent RH. The ambient conditions are 40^0C DBT and 27^0C WBT. The space has a sensible heat gain of 14 kW. Air is supplied to the space at 7^0C saturated. Calculate.
   (a) Mass of moist air supplied to the space in kg/h;
   (b) Latent heat gain of space in kW;
   (c) Cooling load of air washer in kW if 30 percent of the air supplied to the space is fresh, the remainder being recirculated? [16]

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Code No: R05220304 **Set No. 3**

II B.Tech II Semester Regular Examinations, Apr/May 2008
THERMAL ENGINEERING-I
(Common to Mechanical Engineering and Automobile Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Compare the actual cycles and fuel-air cycles of S.I Engine?
   (b) Mention various simplified assumptions used in fuel-air cycle analysis. [8+8]
2. (a) What is ignition lag in S.I. Engine combustion? Explain the influence of different operating parameters on ignition lag.
   (b) What is pre-ignition? Discuss its ill effects on performance. [8+8]
3. (a) What are different stages of combustion in C.I. Engine? Explain with p - θ diagram.
   (b) What is diesel knock? How to minimize knocking in C.I. Engine. [8+8]
4. (a) List the parameters by which performance of an engine is evaluated.
   (b) Find the bore of the single-cylinder diesel engine working on the four-stroke cycle and delivers 40 kW at 200 rpm from the following date:
   Compression ratio : 14:1
   Fuel cut-off : 5% of stroke
   Index of compression curve : 1.4
   Index for expansion curve : 1.3
   Pressure at beginning of compression : 1 atm
   Ratio of stroke to bore : 1.5 to 1. [8+8]
5. The following particulars refer to a two-stage single-acting air compressor. Capacity 4.5 cubic metres per minute measured under free conditions of 15^0C and 1.01325 bar.
   Delivery pressure, 17.5 bar.
   Pressure during suction stroke, 0.98 bar.
   Temperature at start of compression, 30^0C.
   Clearance volume of low pressure cylinder, 6% of stroke volume.
   Index of compression and expansion, 1.25 throughout.
   Speed 120 r.p.m.
   Assuming that the inter-cooler pressure is chosen such that theoretically the work is shared equally between the two cylinders, determine
   (a) the Indicated Power and
   (b) the dimensions of the low pressure cylinder if the bore is equal to the stroke. [16]

6. An uncooled centrifugal compressor of the single-sided impeller type has to deliver 8 kg/s of air with a pressure ratio of 4.4 to 1 at 18000 r.p.m. The entry to the eye, for which the internal diameter is 125 mm, is axial and the mean axial velocity at the eye section is 135 m/s with no pre-whirl. Static pressure and temperature at the eye section are respectively 98 KPa and 15^0C. The isentropic efficiency of compressor is 78% and slip factor 0.92. Neglecting other losses, calculate :
   (a) the rise in temperature during compression if the change in kinetic energy is negligible;
   (b) the tip speed and impeller tip diameter; and
   (c) the external diameter of the eye. [16]

7. (a) With the aid of a neat sketch describe the operation of an absorption refrigeration system. Explain clearly the function of the various components.
   (b) In a 100-ton aqua ammonia absorption refrigeration plant saturated liquid ammonia at 30^0C leaves the condenser and enters the expansion value. The evaporator exit is 10^0C. The mass concentrations of ammonia in the weak and strong solutions are 0.25 and 0.325 respectively. Determine the mass flow rates (kg/min) of the strong and weak solutions. [16]

8. (a) What parameters are controlled in air-conditioning systems ?
   (b) Discuss the requirements of temperature and humidity in high heat load industries.
   (c) Discuss about the ventilation standards for comfort air-conditioning. [16]

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Code No: R05220304 **Set No. 4**

II B.Tech II Semester Regular Examinations, Apr/May 2008
THERMAL ENGINEERING-I
(Common to Mechanical Engineering and Automobile Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Illustrate the constructional details of an I.C engines? Explain briefly about important components?
   (b) How do you classify I.C. Engines? Explain in detail. [8+8]
2. (a) Explain the phenomenon of pre-ignition? How pre-ignition leads to detonation and vice versa? What are the ill effects of pre-ignition?
   (b) How can pre-ignition be detected? What are pre-ignition inhibitors? [8+8]
3. (a) What is the need of air movement in C.I. Engine combustion chamber? Explain.
   (b) Discuss the influence of parameters on diesel knock in C.I. Engine. [8+8]
4. (a) Define Scavenging efficiency? Explain its significance.
   (b) A four stroke diesel engine consumes 4.3 kg of fuel per hour when running at 600 rpm. The engine dimensions are 100 mm bore and 160 mm stroke. If the spring height is 4.5 mm with spring index of 1 bar/mm. Calculate IP, BP, mechanical efficiency and brake thermal efficiency if CV of fuel is 44000 kJ/kg. [6+10]
5. An air compressor takes in air at 1 bar (100 kPa) and 20^0C and compresses it according to the law $pV^{1.2}$ = constant. It is then delivered to a receiver at a constant pressure of 10 bar (1000 kPa). Determine
   (a) the temperature at the end of compression and
   (b) the heat transferred and work done during the compression process per kg of air
   (c) the work done during delivery. Take R = 287 J / kg K and $\gamma = 1.4$. [16]
6. A multistage axial flow compressor with equal work done per stage and same velocity of flow through out the compressor has the following data :

Overall stagnation pressure ratio	= 4
Stagnation inlet temperature	= 50^0 C
Relative air angle at rotor inlet	= 130^0
Relative air angle at rotor outlet	= 100^0
Blade velocity	= 200 m/sec
Degree of reaction	= 0.5

Overall stagnation adiabatic efficiency = 0.85
The data refer to mean blade height and the measurement of angle is done in the same sense from the blade velocity diagram Calculate :

(a) Stagnation outlet temperature

(b) Number of stages. [16]

7. In an ammonia-water absorption system for 40 TR (Tonnes of refrigeration), condenser pressure is 16 bar and evaporator pressure is 4 bar. The designing range is 0.09. The conditions at the entry to the condenser, outlet to the condenser, outlet of the evaporator, inlet to the liquid pump inlet to the generator and outlet to the generator are saturated. Heat exchanger is used between absorber and generator. Reflux temperature is 65^0C. Determine

   (a) Mass of strong solution handled by the pump in kg per second.

   (b) Heat supplied to generator per sec.

   (c) Heat removed in the absorber per sec.

   (d) Exergetic efficiency. [16]

8. (a) Define the term 'effective temperature' and explain its importance in air-conditioning system. Describe the factors which affect effective temperature.

   (b) Moist air enters a chamber at 5^0C DBT and 2.5^0C thermodynamics WBT at a rate of 90 m^3 / min. The barometric pressure is 1.01325 bars. While passing through the chamber, the air absorbs sensible heat at the rate of 40.7 kW and picks up 40 kg/h of saturated steam at 110^0C. Determine the dry and wet bulb temperatures of the leaving air. [16]

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