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

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
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) Discuss the basis for classification of I.C Engines? Explain in detail.
   (b) Explain the working principle of two stroke S.I engine with a diagram? [8+8]
2. (a) Explain the influence of different parameters on detonation in S.I. Engine.
   (b) Describe the desirable characteristics for better combustion chamber for S.I. Engine. [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) 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. A single-acting , water-cooled air compressor was originally installed to deliver air at an absolute pressure of 5 bar. Clearance volume is 5% of the stroke volume. The law of compression and expansion followed is $pV^{1.25}$. It is proposed to increase the delivery pressure to 7 bar, keeping the speed of the machine unchanged. The compressor is capable of working under the new conditions but the driving motor is already loaded to its maximum rated capacity and can accept no increase in load. Determine the percentage increase in the compressor volume, which at the new delivery pressure will ensure that driving power remains unchanged. How will the mass of air delivered be effected. Assume the mechanical efficiency of the compressor is independent of the load and that index of compression and expansion remains unaltered. Pressure at the end of suction is atmospheric and is equal to 0.985 bar. [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) Why is evaporator pressure kept above atmospheric in most refrigeration systems?

(b) What is the advantage of using secondary refrigerants? What are the common secondary refrigerants?

(c) Explain with a suitable diagram, the working of cascade refrigeration system. Why and where does this system find itself particularly useful? [16]

8. (a) Discuss briefly the different types of heat loads which have to be taken into account in order to estimate the total heat load of a large restaurant for summer air-conditioning.

(b) A room has a sensible heat gain of 24 kW and a latent heat gain of 5.2 kW, and it has to be maintained at 26^0 C DBT and 50% RH. 180 m^3 / min of air is delivered to the room. Determine the state of supply air : DBT and WBT. [16]

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

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
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) What are different fuel injection systems for C.I engines? Explain any one?
   (b) Sketch and explain the valve timing diagram for 4 stroke S.I engines? [8+8]
2. (a) What are different stages of combustion in S.I. Engine and how much quantity of heat is released in different stages?
   (b) Draw the schematic diagrams of I-type, L-type and F-type combustion chamber and compare the salient features among them. [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) Explain the principle of prony brake and rope brake in measuring engine power.
   (b) The output of a single cylinder four stroke IC engine is measured by a rope brake dynamometer. The diameter of the brake pulley is 750 mm and rope diameter 50 mm. The dead load on the tight side of the rope is 400 N and the spring balance reading is 50 N. The bore is 150 mm and stroke is 190 mm. The engine consumes 4 kg/h of fuel at rated speed of 1000 rpm. The calorific value of the fuel is 44 MJ/kg. Calculate the brake specific fuel consumption, bmep and the brake thermal efficiency. If the mechanical efficiency is 80% , calculate the IP, imep, indicated specific fuel consumption and indicated thermal efficiency. [4+12]
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. (a) With the help of neat sketches explain a Roots Air Blower. How its p-v diagram is different from a reciprocating air compressor.

(b) Determine the work done per revolution in driving the compressor when

i. ports are so placed that no internal compression takes place as in case of Roots Blower

ii. the ports are so placed that there is 50% pressure rise due to internal adiabatic compression before back flow occurs. Also determine the efficiency in both cases. [16]

7. (a) State the desirable properties of a refrigerant. Which element in CFCs reacts with ozone? What is meant by global warming?

(b) It is proposed to replace R-12 by ozone friendly R-134a in a refrigeration plant of 10 TR capacity with evaporator and condenser temperatures of 0^0C and 40^0C respectively. Considering standard saturation cycle (evaporator exit and condenser exit as saturated states), compare the mass flow rate, compressor work (kW), condenser heat rejection (kW) and COP for the two refrigerants. The saturation properties and vapour specific heats are as follows: (TR= Tons of refrigeration) [16]

8. For an air-conditioned space, the RSH and RLH are 25 kW and 5 kW respectively. The room condition is 25^0C DBT, 50% RH. The outdoor condition is 40^0C DBT, 50% RH. The ventilation requirement is such that on mass flow rate basis 20% of fresh air is introduced and 80% of supply air is recirculated. The bypass factor of the cooling coil is 0.15.

(a) Determine enthalpy and humidity ratio of indoor and outdoor air then considering adiabatic mixing determine temperature, humidity ratio and enthalpy of air at inlet of cooling coil.

(b) Let t_2 and W_2 be the conditions of air leaving the cooling coil. Set up three equations for the unknowns t_2, W_2 and t_{ADP}, one using ratio of RSH/RLH and two equations by definition of bypass factor. [16]

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

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
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) Explain the principle operation of an I.C .Engine with neat sketch?
   (b) Why the exhaust valve is opened before BDC and closed after TDC? [8+8]
2. (a) Describe the mixture requirement in S.I. Engine for different speed conditions. How to achieve above requirements from the carburetor.
   (b) What are different types of combustion chambers used in S.I.Engine? [10+6]
3. (a) What are different four stages of combustion in C.I. Engine? Explain salient features.
   (b) How to minimize diesel knock? Explain different controlling methods. [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. A single acting two stage compressor with complete inter cooling delivers 6 kg/min of air at 16 bar. Assuming an intake at 1 bar and 15^0C and compression and expansion with the law $pV^{1.3} = C$. Calculate.
   (a) Power required to run the compressor at 420 rpm
   (b) Isothermal efficiency
   (c) Free air delivered per sec.
   (d) If clearance ratios for LP and HP cylinder are 0.04 and 0.06, calculate volumetric efficiency and swept volume for each cylinder.
   (e) Net heat transferred in LP and HP cylinders during compression and also in the intercooler. Assume R = 0.287 kJ/kg K, C_v = 0.71 kJ/ kg K. [16]
6. The conditions of air at the entry of an axial compressor stage are p_1 = 768 mm Hg and T_1 = 314 K. The air angles are $\beta_1 = 51^0$, $\beta 2 = 9^0$, $\alpha_1 = \alpha_3 = 7^0$ The mean diameter and peripheral speed are 50 cm and 100 m/s, respectively. Mass-flow rate through the stage is 25 kg/s; the work-done factor is 0.95 and mechanical efficiency 92%. Assuming a stage efficiency of 88% determine:

(a) air angle at the stator entry,

(b) blade height at entry and the hub-tip diameter ratio,

(c) stage loading coefficient,

(d) stage pressure ratio, and

(e) the power required to drive the stage. [16]

7. (a) In respect of a reciprocating refrigerant compressor, define the team 'volumetric efficiency' and discuss the factors which effect it.

(b) A dense air refrigerating system operating between pressures of 16 bars and 4 bars is to produce 10 tons of refrigeration. The air temperature leaving the refrigerating coils is-7^0C and the air temperature leaving the air cooler is 17^0C. Assuming no losses and no clearance, calculate the mass of air in circulation (kg/min), power required (kW), and piston displacement for the compressor (m^3 /min). For air C_p= 1.005 kJ/kg K, R=0.287 kJ/kg. K. [16]

8. (a) What is the bypass factor ? Explain its usefulness.

(b) The air-handling unit of an air-conditioning plant supplies a total of 4500 c. mm. of dry air which comprises by weight 20 per cent fresh air at 40 C DBT and 27^0C WBT and 80 per cent recirculated air at 25^0C DBT and 50 per cent RH. The air leaves the cooling coil at 13^0C saturated state. Calculate the total cooling and room heat gain. [16]

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

II B.Tech II Semester Supplimentary Examinations, Aug/Sep 2007
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) Describe the mixture requirement in S.I. Engine for different speed conditions. How to achieve above requirements from the carburetor.
   (b) What are different types of combustion chambers used in S.I.Engine? [10+6]
3. (a) Explain the influence of turbulence and speed on delay period in C.I. Engine combustion.
   (b) Draw the schematic diagram of Air cell combustion chamber and explain its working principle. [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 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) Sketch streamlines in the meridional and vane-to-vane planes of a centrifugal compressor impeller. Draw typical velocity profiles at the impeller exit from hub-to-tip and vane-to-vane.
   (b) Derive the following relations for the velocities in meridional and vane-to-vane planes. :
   $\frac{\partial_w}{\partial^m} + \frac{w}{R} - 2\omega = 0 \qquad w = k \exp \int \frac{dn}{R}$ Where w = Relative velocity, m = Distance in Meridional, R = Radius of Curvature, ω = Rotational speed in rad/s, n = Natural coordinate. k = constant. [16]

7. (a) Write down two main thermodynamic requirements and desirable characteristics of Refrigerant-absorbent pair for an absorption-refrigeration system.

   (b) An ammonia-water absorption system works using saturated steam supplied at 2 bars with 20 K of temperature needed for heat transfer. The evaporator pressure is maintained at 4 bars and the absorber temperature is 303 K. The vapour leaving the the generator is 100% pure NH_3 saturated vapour and liquid leaving the condenser is saturated liquid. The condensate is sub-cooled by 10^0C by the vapour leaving the evaporator. The mass flow rate vapour leaving evaporator is 1 kg/s. Determine:

      i. Refrigeration capacity;

      ii. Heat rejection in the condenser. [16]

8. A conference room for seating 100 persons is to be maintained at 22^0C DBT and 60% RH. The outdoor conditions are 40^0C DBT and 27^0C WBT. The various loads in the auditorium are : sensible and latent heat loads per person, 80 W and 50 W respectively ; lights and fans 15000 W. Air infiltration is 20 m^3/min and fresh air supply is 100 m^3/min. Recirculated room air and fresh air are mixed before entering the cooling coils. The bypass factor of the coils is 0.1. Determine the grand total heat load, ESHF and ADP. [16]

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