BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2009-2010

Sub : **IPE 431** (Machine Tools)

Full Marks : 210   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Perform the Productivity Analysis for G. P. Layout of Speeds for following design requirements, **(16)**

         Minimum speed, n_1 = 15 rpm

         Maximum speed, n_z = 130 rpm

         No. of speed step, z = 9

         Cutting speed, V_c = 15 m/min

         Depth of cut, a = 5 mm (at a time)

     (b) An axial piston pump with swash plate rotates at 1500 rpm. Calculate it's maximum supply capacity if the following dimensions are given; number of piston = 9, piston diameter = 6 mm, radius of the piston circle = 25 mm, maximum angle of inclination of the swash plate = 20°. **(12)**

     (c) How many gears will be needed for a tumbler gear system having 10 speeds? **(7)**

2. (a) Suppose you are asked to design a gearbox having 6(six) speed at the output shaft, using sliding type cluster gears. Draw necessary "Ray diagram" for possible combinations and select the best design using proper conditions and guidelines. **(17)**

     (b) Briefly describe the working principle of "Gear Pump" with neat sketch and derive the equation for delivery rate, Q and power P. **(10)**

     (c) For "sliding type cluster gears" show that the difference in the number of teeth of adjacent gears of a cluster must be at least 4(four). **(8)**

3. (a) Deduce the equation of different reaction forces acting on the mating surface in a combination of Vee and flat slideways. **(15)**

     (b) Briefly explain different methods of clearance adjustment in Dovetail slideways. **(10)**

     (c) Write short note on Hydrostatic slideways with neat sketch. List the advantages of hydrostatic slideways. **(10)**

4. (a) Write a CNC part program for machining a rectangular block ($4'' \times 3'' \times 0.5''$) using CNC vertical milling machine. Consider X_0 and Y_0 at lower left corner, Z_0 at top of the part for part zero, cutter 0.6" end mill. Blank is in irregular shape. [Given, spindle rpm = 1000, Spindle rotation is anti-clock-wise and Feed rate = 2" /min] **(15)**

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(b) Why is ergonomics and anthropometry important in the design of machine tool control? Mention some design considerations related to ergonomics. **(8)**

(c) Calculate the speed of a 3 ϕ 4 pole stepper motor while receiving 1800 pulse/minute. **(6)**

(d) What are the difference between Jigs and Fixtures? Explain the 3-2-1 principle for locating. **(6)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) What do you mean by precision threads? How do you cut precission threads in a certain lathe Machine? Discuss briefly. **(9)**

(b) Where do you use worm gearing and half-nut in a lathe machine? Discuss the mechanism and purposes of them. **(8)**

(c) Why do you use collect chucks in turret lathe? Discuss different types of collet chucks with appropriate sketches. **(6)**

(d) What do you mean by standard Accessories of lathe machine? Discuss the mechanisms and applications of different types of standard accessories of a lathe machine. **(12)**

6. (a) What are the conditions for which we can get involute profile even in the form cutting method? Discuss the fly-cutting process along with its applications. **(8)**

(b) How can you understand the gear cutting by gear shaper produces involute profile? Discuss briefly. **(8)**

(c) Discuss the principle of differential indexing in detail. **(12)**

(d) Discuss the cutter setting mechanism in a horizontal spindle milling machine. **(7)**

7. (a) Discuss different motions involved in gear shaper for helical gear cutting. **(9)**

(b) What do you understand by single pass and double pass system in gear shaper? Explain. **(6)**

(c) What are the feature of a hob cutter? Discuss the setting of hob cutter for cutting spur and helical gear. **(10)**

(d) Discuss different types of acceptance tests in detail. Explain a accuracy test for straightness of a lathe bed. **(10)**

8. (a) Mention the effect of chip on the design of machine tool structure. **(10)**

(b) Why is cast iron the most widely used material for manufacturing machine tool bed? Mention specific reasons to support your answer. **(10)**

(c) Why is preloading necessary in a spindle bearing? In how many ways a bearing in the spindle can be preloaded. **(15)**

List of G-code for CNC Milling/Turning Operations

G-code	Description	G-code	Description
G00	Rapid traverse	G40	Tool (nose) radius compensation cancel
G01	Linear interpolation	G41	Tool (nose) radius compensation left
G02	Clockwise circular interpolation	G42	Tool (nose) radius compensation right
G03	Counterclockwise circular interpolation	G54-59	Workpiece coordinate system 1-6 selection
G20	Inch data input	G90	Absolute command programming
G21	Metric data input	G91	Incremental command programming
G28	Automatic return to the reference point	G92	Zero offset setting

G-code	Description	G-code	Description
G50	Maximum spindle speed command	G85	Call for rough bar turning cycle
G80	End of shape designation	G87	Call for finishing turning cycle
G81	Start of longitudinal shape designation	G96	Constant cutting speed
G82	Start of traverse shape designation	G97	Fixed RPM

List of M-code for CNC Milling/Turning Operations

M-code	Description	M-code	Description
M02	End of program	M06	Tool change
M03	Spindle clockwise	M08	Coolant on (spray)
M04	Spindle counterclockwise	M09	Coolant off
M05	Spindle stop	M30	End of program

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2010-2011

Sub : **ME 401** (Internal Combustion Engines)

Full Marks: 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.

Symbols indicate their usual meaning. Assume reasonable values for missing data, if there is any. Necessary charts and figures are attached.

1. (a) What are the physical differences between the Otto and diesel engines? **(5)**

   (b) Define and explain the terms 'blow-by' and 'crevice volume'. **(5)**

   (c) What are the different methods used to control the thermal expansion of SI engine pistons? Explain with neat sketches. **(15)**

   (d) What is 'Morse test'? Why and how is it done? **(10)**

2. (a) Briefly explain why the particulate emission levels from diesel engines and conventional SI engines are so different in magnitude. **(8)**

   (b) Discuss the mechanics of CO formation and emissions from conventional SI engines and CI engines. **(15)**

   (c) Explain with the help of a p-V diagram, what happens to the indicated efficiency when the expansion ratio of constant-volume cycle is increased keeping the compression ratio and other details of the cycle remain the same. How can the expansion ratio be increased in such case? **(7)**

   (d) Why should new engines be operated at low speeds and loads. **(5)**

3. (a) Compare the fuel injection systems of CI and SI engines. **(8)**

   (b) Discuss the requirements for a good CI engine fuel. **(7)**

   (c) A fuel has the following gravimetric composition: **(20)**

pentane (C_5H_{12})	15%
heptane (C_7H_{16})	35%
octane (C_8H_{18})	40%
benzene (C_6H_6)	10%

   If the gravimetric air-fuel ratio is 17:1, determine the equivalence ratio.

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4. (a) Compare, with neat schematics, by-pass and full-flow oil filtering. **(8)**

(b) Show the knock phenomenon on a plot of pressure versus crank-angle degrees (CAD) and explain. **(8)**

(c) Find the indicated mean effective pressure and the work of the cycle for the following SI engine. **(19)**

The fuel vapor-air mixture enters the cylinder before compression at a pressure of 1 atm and a temperature of 350 K. The pressure in the cylinder at TC immediately following combustion is 6,500 kPa.

The compression ratio is 8 and the F/A equivalence ratio is 0.8. The fuel is iso-octane (C_8H_{18}). Consider that both the compression and expansion processes are approximately isentropic.

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Briefly explain laminate flame speed and burning velocity. Mention some of the key factors affecting laminate flame speed. **(10)**

(b) Classify combustion systems with suitable examples. **(5)**

(c) Briefly explain the physical meaning of LHV. **(5)**

(d) Estimate the air fuel ratio of stoichiometric methane-air combustion. **(5)**

(e) Write short notes on **(10)**

    (i)   SIT

    (ii) Adiabatic flame temperature

6. (a) What are the objective of CI fuel metering? Briefly explain the phases of a CI engine combustion. **(15)**

(b) Briefly explain the A/F requirement of a SI engine for the following 3 conditions **(9)**

    (i)   engine idling

    (ii) engine acceleration

    (iii) fast motoring on a level ground.

(c) Make briefly comparison between SI and CI engine combustion. **(6)**

(d) What is meant by GDI engines? **(5)**

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7. (a) Draw typical ideal and actual P-v diagram of an Otto engine cycle. Briefly explain and quantify various losses in actual engines. **(15)**

(b) Make a brief comparison between SI engine and CI engine knock. **(10)**

(c) Briefly explain the phases of a SI engine combustion. **(10)**

8. (a) Briefly explain EFI system in SI engines. **(15)**

(b) Show hat, for air-standard otto-cycle. **(10)**

$$\eta_{th} = 1 - \left(\frac{1}{r}\right)^{k-1}$$

(c) Make a brief comparison between SI and CI engine cycle. **(5)**

(d) Assuming reasonable values of bmep and piston speed, estimate the power developed by a 1 liter SI engine. **(10)**


$$\Psi(T_2) = \Psi(T_1) - n_u \tilde{R} \ln \left(\frac{v_2}{v_1}\right)$$

$$\Phi(T_2) = \Phi(T_1) + n_u \tilde{R} \ln \left(\frac{p_2}{p_1}\right)$$

Unburned mixture composition for charts

| Equivalence ratio ϕ	(F/A)	Kilograms of mixture per kilogram of air	Moles of mixture per mole of O_2	Kilomole of mixture per kilogram of air	$n_u \tilde{R}$,† J/kg air · K
0.4	0.0264	1.0264	$4.805 + 0.112x_b$	$0.0348 + 0.00081x_b$	289
0.6	0.0396	1.0396	$4.821 + 0.168x_b$	$0.0349 + 0.00122x_b$	290
0.8	0.0528	1.0528	$4.837 + 0.224x_b$	$0.0350 + 0.00162x_b$	291
1.0	0.0661	1.0661	$4.853 + 0.280x_b$	$0.0351 + 0.00203x_b$	292
1.2	0.0792	1.0792	$4.869 + 0.536x_b$	$0.0352 + 0.00388x_b$	292

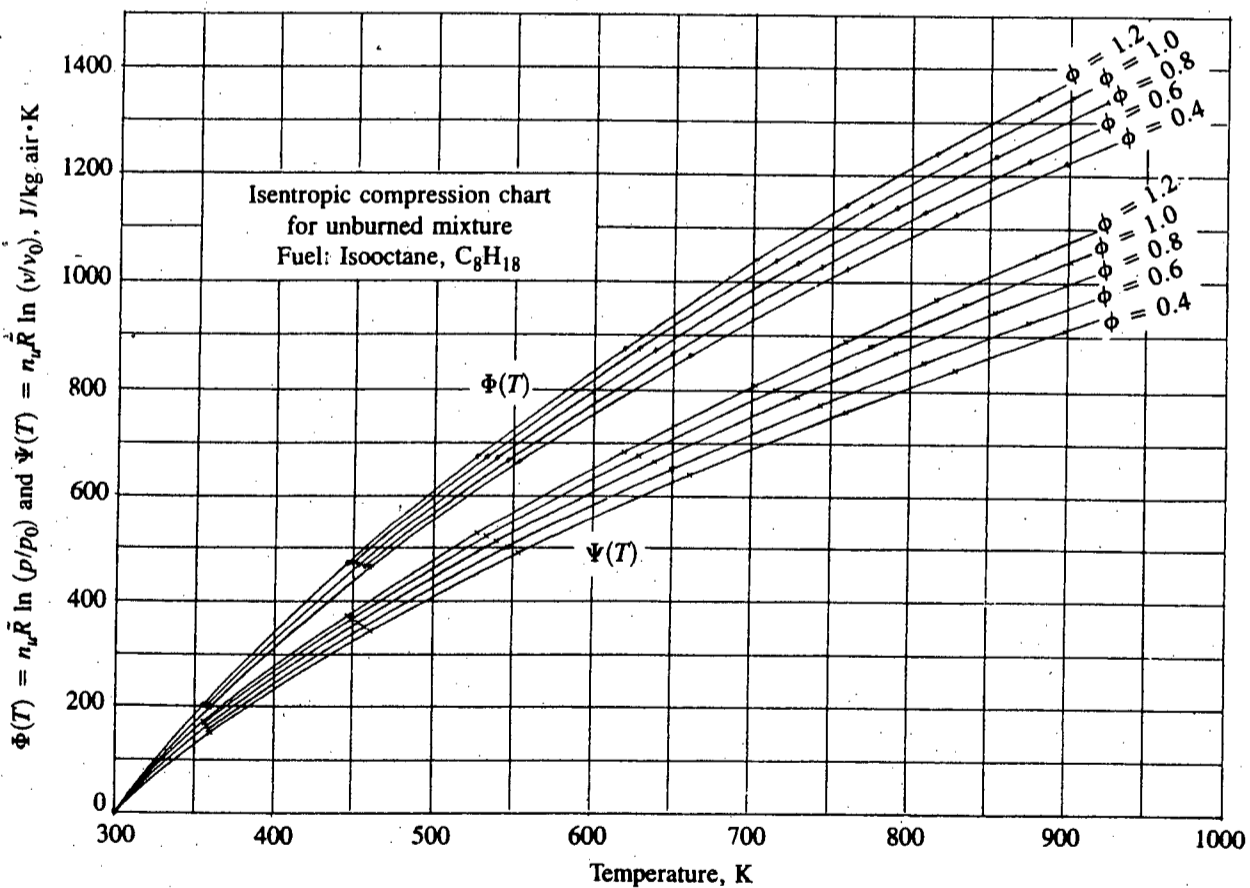† For $x_b = 0$. Error in neglecting x_b is usually small.
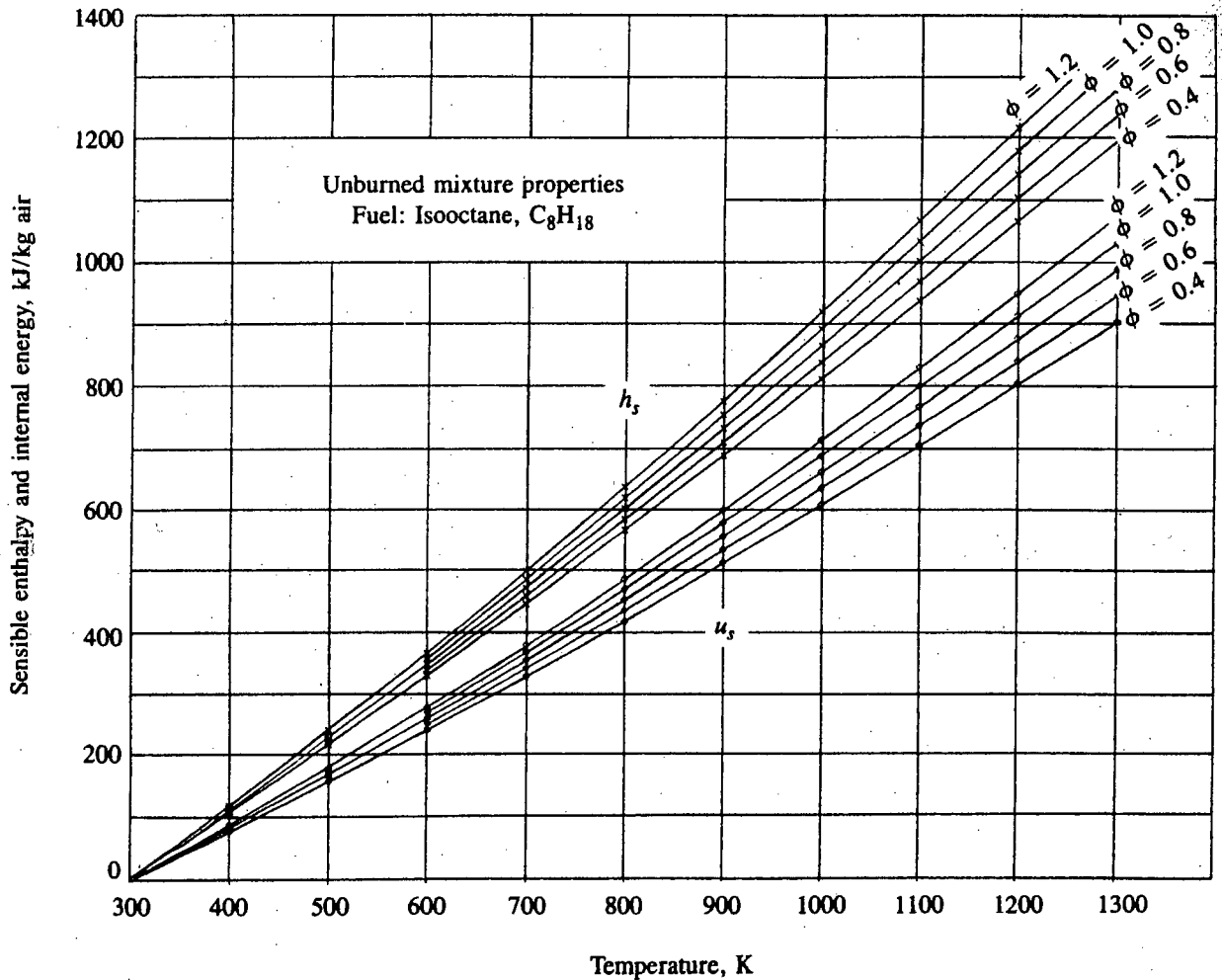
Sensible enthalpy and internal energy of unburned isooctane-air mixtures as function of temperature. Units: kJ/kg air in mixture.
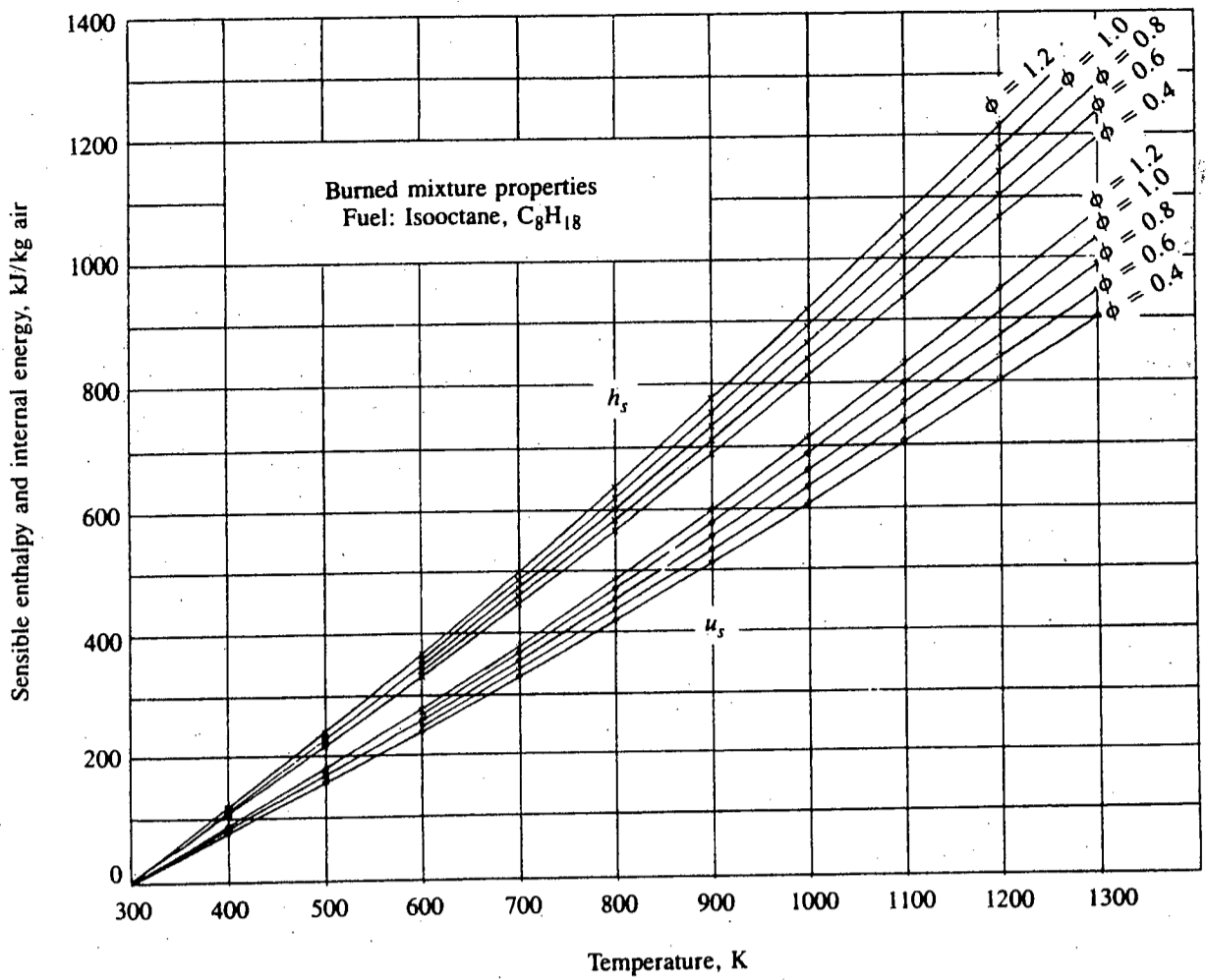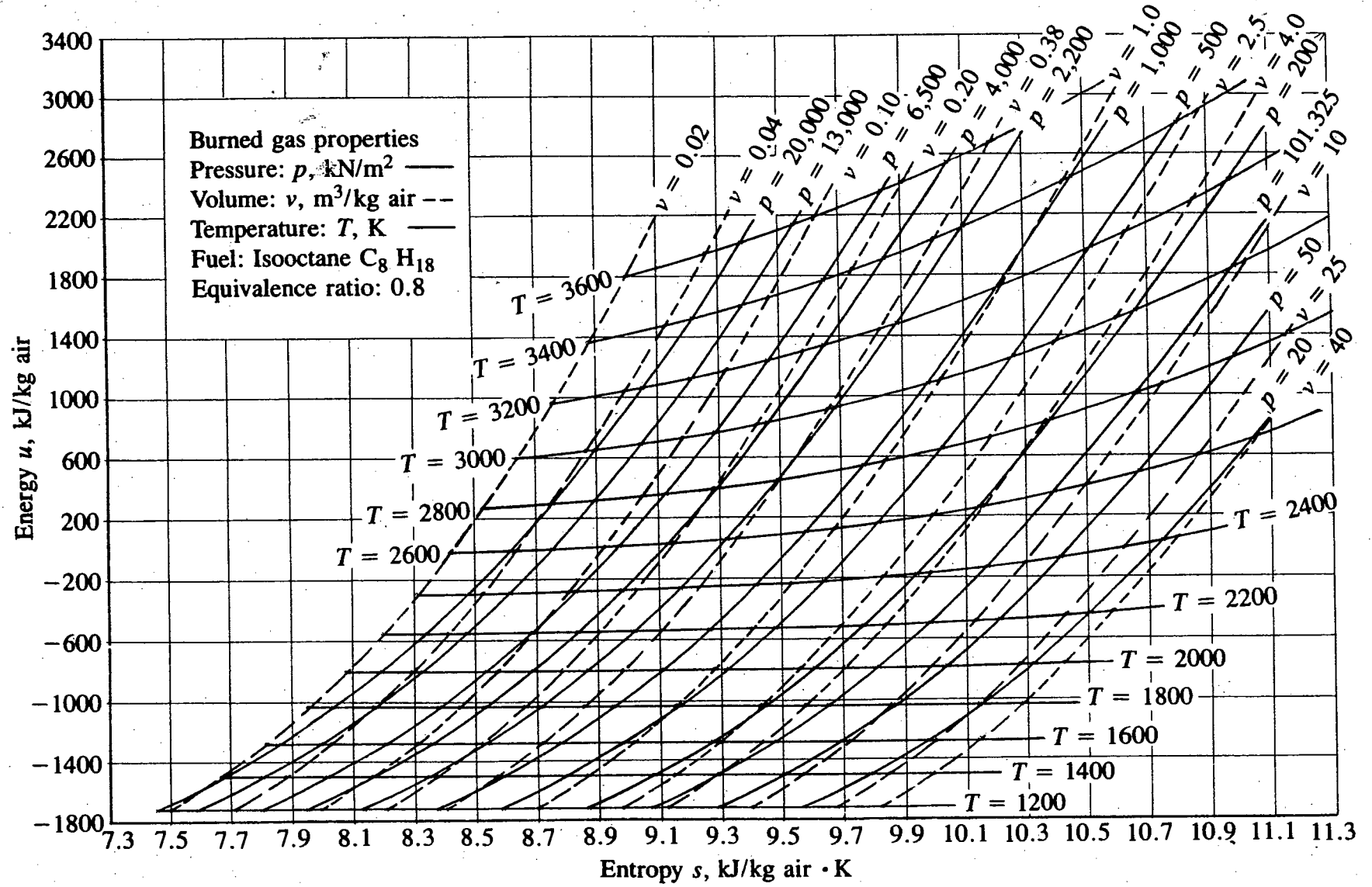
Sensible enthalpy and internal energy of low-temperature burned gases as function of temperature, isooctane fuel. Units: kJ/kg air in original mixture.

Isentropic compression functions, Φ and Ψ, as function of temperature for unburned isooctane-air mixtures. Units: J/kg air $\cdot$ K.

Internal energy versus entropy chart for equilibrium burned gas mixture, isooctane fuel; equivalence ratio 0.8.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1   B. Sc. Engineering Examinations 2010-2011

Sub : **ME 415** (Refrigeration & Building Mechanical Systems)

Full Marks: 210   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this Section. Answer any **THREE**.
Refrigeration and A/C Data book will be provided.
Assume any reasonable value, if required.

1. Estimate the cooling load of an office room at 4:00 PM for the following conditions: **(35)**

# Location	:	Chittagong
# Data	:	16th May
# Floor	:	10 m × 10 m. Height = 3 m.
# Roof	:	type 4, 100 mm concrete with 50 mm insulation.
# Walls	:	101 mm face brick + 101 mm common brick (type D).
# Windows	:	20% of wall area, 13 mm clear glass, U = 3.0 w/m²–C.
# Lights	:	15 w/m², fluorescent bulb.

5 people using 3 computers @ 100 w.
:

Assume negligible heat transfer through south and east walls. Also assume ASHRAE standard in door design conditions and ventilation air supply.

2. (a) Make a brief comparison between window type and split type A/C.   **(10)**

(b) Briefly explain the factors affecting thermal comfort.   **(5)**

(c) Briefly explain the physical meaning of wet-bulb temperature and dew-point temperature.   **(10)**

(d) Write short notes on   **(10)**

   (i) Air-craft A/C system

   (ii) VAV system.

3. (a) Briefly explain, with schematic diagram and processes on a typical psychrometric chart, summer a/c system with by-pass.   **(10)**

(b) A space is to be maintained at 25°C & 50% RH. The space has a sensible heat gain of 50 kW and a moisture gain of 20 kg/hr. Moist supply air eaters the space at 15°C and outdoor air is at 35°C & 75% RH. Fresh air supply is 1.0 m³/s.   **(15)**

The system is an elementary summer A/C. Estimate

   (i)   condition of supply air
   (ii)   Required chiller capacity.

(c) Atmospheric air at 35°C & 75% RH is isothermally compressed to 1.0 MPa pressure. Estimate the final state of air. **(5)**

(d) Briefly explain the equal friction duct design method. **(5)**

4. (a) Make a brief comparison between a hydraulic lift and a conventional lift. **(5)**

(b) Mention the typical safety devices used in lifts. **(5)**

(c) Mention some of the ideal performance parameers of a passenger lift. **(5)**

(d) Briefly explain the fire extinguishneat mechanisoms used in lifts. **(10)**

(e) Classify flammable liquids based on fire ratings. **(5)**

(f) Give examples of sensors used in typical lifts. **(5)**

SECTION – B
There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Draw the block diagram of a basic vapor compression refrigeration system and briefly describe various processes involved. **(10)**

(b) Describe how actual vapor compression refrigeration cycle differs from the basic vapor compression refrigeration cycle. **(05)**

(c) A standard vapor-compression cycle developing 50 kW of refrigeration cycle using R-134a operates with a condensing temperature of 35° C and an evaporating temperature of −10 °C. Calculate **(20)**

    (i) the refrigeration effect

    (ii) the circulation rate of refrigerant

    (iii) the power requirements of the compressor

    (iv) the coefficient of performance (C.O.P)

    (v) the power per kilowatt of refrigeration

6. (a) Classify different types of compressors used in refrigeration systems and hence briefly describe the working principle of a rotary sliding vane type compressor. **(15)**

(b) Briefly describe the working principle of an evaporative condenser. **(10)**

(c) Describe the working principle of a thermostatic expansion valve. **(10)**

7. (a) Write down the advantages of vapor absorption refrigeration system over vapor compression refrigeration system. **(10)**

(b) In a vapor absorption system using LiBr, T_G = 100 °C, T_E = 10 °C, T_a = 30 °C, and T_c = 40 °C. Estimate the values of C.O.P for the following conditions: **(25)**

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(i) Carnot cycle

(ii) Real cycle if pump delivers 0.6 kg/s solutions

(iii) If a heat exchanger is inserted after the pump and the water eners the generator at 52 °C.

8. (a) Why multi pressure systems are used in industrial applications? **(10)**

(b) Calculate the power required by the compressors in an ammonia system which serves a 250 kW evaporator at -25 °C. The system uses a two-stage compression with intercooling and removal of flash gas. The condensing temperature is 35 °C. Also compare the power requirements against a single compressor system developing 250 kW of refrigeration at -25 °C with a condensing temperature of 35 °C. **(25)**