BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-2/T-2   B. Sc. Engineering Examinations 2014-2015
Sub : **MME 235** (Heat and Mass Transfer)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.
USE SEPARATE SCRIPTS FOR EACH SECTION

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SECTION – A
There are **FOUR** questions in this section. Answer any **THREE**.
Use Figure 5 and Table 1, where necessary.

1. (a) Distinguish between thermal boundary layer and concentration boundary layer for a flow over a flat surface. Derive the expressions for local and mean heat transfer coefficients over a distance of x = 0 to x = L along the surface.   **(20)**

   (b) At some location on the surface of a pan of water, measurements of the partial pressure of water vapor p_A (atm) are made as a function of the distance y from the surface, and the results are shown in Figure 1(b). Determine the convection mass transfer coefficient $h_{m,x}$ at this location. For water vapor-air interface, diffusion coefficient can be taken as 0.288×10^{-4} m^2/s.   **(15)**

2. (a) On a summer day the air temperature is 27°C and the relative humidity is 30%. Water evaporates from the surface of a lake at a rate of 0.10 kg/h per square meter of water surface area. The temperature of the water is also 27°C. Determine the value of the convection mass transfer coefficient. For saturated water vapor, $\rho_{A,\,sat} = 0.02556$ kg/m^3.   **(6)**

   (b) Derive kirchoff's law of radiation.   **(12)**

   (c) Consider air flow over a flat plate of length L = 1m under conditions for which transition occurs at x_c = 0.5 m based on the critical Reynolds number, $Re_{x,c} = 5 \times 10^5$.   **(17)**
   For air at T = 350 K: k = 0.030 W/m.K, ρ = 974 kg/m^3, $\mu = 365 \times 10^{-6}$ N.s/m^2.

   (i) Determine the air velocity at 350 K.

   (ii) In the laminar and turbulent regions, the local convection coefficients are, respectively, $h_{lam}(x) = C_{lam}\, X^{-0.5}$ and $h_{turb} = C_{turb}\, X^{-0.2}$ where, at T = 350 K, C_{lam} = 8.845 W/m$^{3/2}$.K, C_{tur} = 49.75 W/m$^{1.8}$.K and x has units of m. Develop an expression for the average convection coefficient, as a function of distance from the leading edge, x, for the laminar region, $0 \le x \le x_c$.

   (iii) Develop an expression for the average convection coefficient, as a function of distance from the leading edge, x, for the turbulent region, $x_c \le x \le L$.

3. (a) A surface emits as a blackbody at 1500 K. What is the rate per unit area (W/m^2) at which it emits radiation over all directions corresponding to $0° \le \theta \le 60°$ and over the wavelength interval 2 μm $\le \lambda \le$ 4 μm?   **(17)**

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Contd ... Q. No. 3

(b) The spectral transmissivity of plain and tinted glass can be approximated as follows: Plain glass: $\tau_\lambda = 0.9$ for $0.3 \leq \lambda \leq 2.5$ μm; Tinted glass: $\tau_\lambda = 0.9$ for $0.5 \leq \lambda \leq 1.5$ μm. Outside the specified wavelength ranges, both glasses are opaque to radiation. Compare the solar energy that could be transmitted through the glasses. **(18)**

4. (a) Determine the view factor F_{14} for the configuration shown in Figure 4(a). **(17)**

(b) In manufacturing, the special coating on a curved solar absorber surface of area $A'_2 = 15$ m^2 is cured by exposing it to an infrared heater of width w = 1 m. The absorber and heater are each of length L = 10 m and are separated by a distance of H = 1 m. The upper surface of the absorber and the lower surface of the heater are insulated. The heater is at $T_1 = 1000$ K and has an emissivity of $\varepsilon_1 = 0.9$, while the absorber is at $T_2 = 600$ K and has an emissivity of $\varepsilon_2 = 0.5$. The system is in a large room whose walls are at 300 K. What is the net rate of heat transfer of the absorber surface? [See Figure 4(b)]. **(18)**

SECTION – B

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

5. (a) A cylindrical furnace has inside radius 30 cm and outside radius 42 cm. The inside flame temperature of the furnace is 1300°C and the outside ambient temperature is 25°C. The thermal conductivity of the wall is 0.5 W/m.°C. The heat transfer coefficient on both sides of the wall is 200 W/m².°C. (i) Calculate the heat loss/m through the wall and (ii) the inside and outside surface temperatures of the wall at steady state condition. **(17)**

(b) The composite wall of an oven as shown in Fig. 6 consists of three materials, two of which are of known thermal conductivity, $K_A = 20$ W/m.°C and $K_C = 50$ W/m.°C, and known thickness, $L_A = 0.30$ m and $L_C = 0.15$ m. The third material, B, which is sandwiched between materials A and C, is of known thickness, $L_B = 0.15$ m, but unknown thermal conductivity K_B. Under steady-state operating conditions, measurements reveal an outer surface temperature of $T_{s,o} = 20$°C, an inner surface temperature of $T_{s,i} = 600$°C, and an oven air temperature of $T_\infty = 800$°C. The inside convection coefficient h is known to be 25 W/m².°C. What is the value of K_B? **(18)**

6. (a) Fig. 7 shows a conical section fabricated from pure aluminium. It is circular cross section having diameter, $D = ax^{1/2}$, where $a = 0.5$ $m^{1/2}$. The small end is located at $x_1 = 25$ mm and the large end at $x_2 = 125$ mm. The end temperatures are $T_1 = 600$ K and $T_2 = 400$ K, while lateral surface is well insulated.

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Contd ... Q. No. 6(a)

(i) Derive an expression for the temperature distribution T(x) assuming one-dimensional steady-state conditions. **(6)**

(ii) Sketch the temperature distribution. **(6)**

(iii) Calculate the heat rate q_x. **(6)**

(b) (i) Derive an expression for critical insulation radius on a tube. **(10)**

(ii) A thin-walled copper tube of outside diameter, 2.5 cm is to be insulated with a layer of asbestos of thermal conductivity 0.2 W/m.°C. The convection heat transfer coefficient from the surface of the asbestos to the ambient air is 12 W/m^2.°C. Calculate the critical thickness of the insulation. **(7)**

7. (a) Using lumped capacitance method derive an expression for the temperature of a solid as a function of time. **(15)**

(b) When is lumped capacitance method not applicable? Why? **(5)**

(c) Carbon steel (AISI-1010) shafts of 0.1-m diameter are heat treated in a gas-fired furnace whose gases are at 1200 K and provide a convection coefficient of 100 W/m^2.K. If the shafts enter the furnace at 300 K, how long must they remain in the furnace to achieve a centerline temperature of 800 K. **(15)**

> Properties of AISI-1010 carbon steel:
>
> Density, $\rho = 7832$ kg/m^3
>
> Thermal conductivity, k = 51.2 W/m.K
>
> Specific heat, c = 541 J/kg.K
>
> Thermal diffusivity, $\alpha = 1.21 \times 10^{-5}$ m^2/s

8. (a) Derive the two-dimensional nodal finite-difference equations for the following configurations under steady-state conditions.

(i) Node (m, n) on a diagonal boundary (Fig. 8) subjected to convection with a fluid at T_∞ and a heat transfer coefficient h. Assume $\Delta x = \Delta y$. **(10)**

(ii) Node (m, n) at the tip of a cutting tool (Fig. 9) with the upper surface exposed to a constant heat flux q_0'' and the diagonal surface exposed to a convection cooling process with the fluid at T_∞ and a heat transfer coefficient h. Assume $\Delta x = \Delta y$. **(10)**

(b) A one-dimensional slab of thickness 2L (Fig. 10) is initially at a uniform temperature T_i. Suddenly, electric current is passed through the slab causing uniform volumetric heating $\dot{q}$ (W/m^3). At the same time, both surfaces (x = ± L) are subjected to a convection process at T_∞ with a heat transfer coefficient h. **(15)**

Derive the explicit finite-difference equation expressing conservation of energy for node 0 located on the outer surface at x = –L. Introduce Fourier and Biot numbers in the equation and express stability criterion.

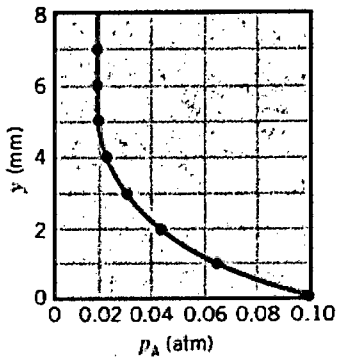--

Figure 1(b)

$L_1 = l_2 = L_4 = W/2$
$L_3 = W$

Figure 4(a)

Collector, $L = 10$ m

$T_2 = 600$ K, $A_2 = 15$ m^2,
$\varepsilon_2 = 0.5$

$T_3 = T_{sur} = 300$ K
$\varepsilon_3 = 1$

$H = 1$ m

$T_1 = 1000$ K, $A_1 = 10$ m^2,
$\varepsilon_1 = 0.9$

$W = 1$ m

Heater, $L = 10$ m
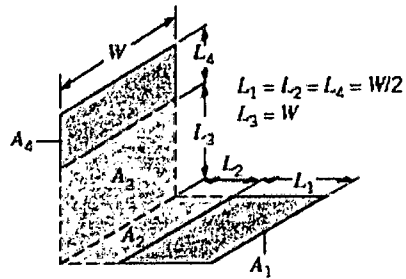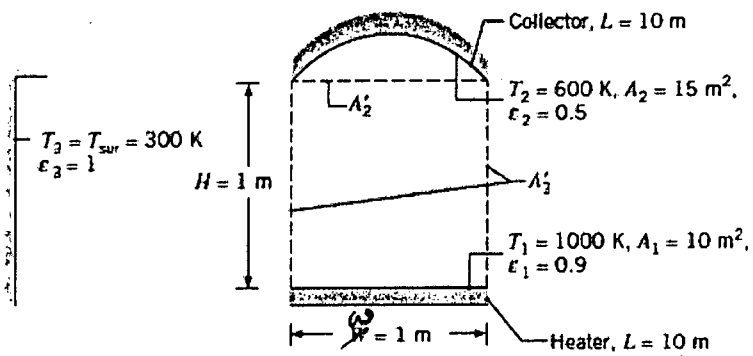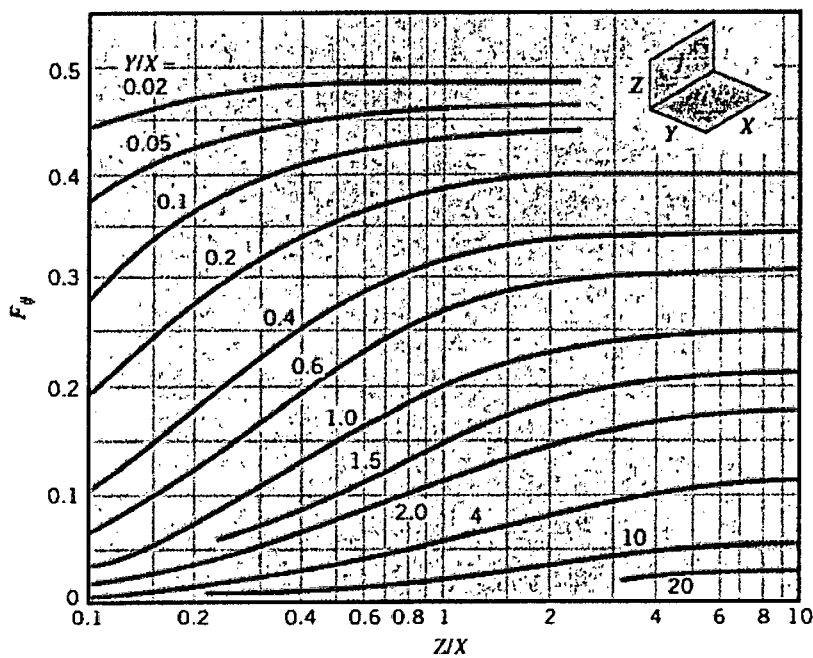
Figure 4(b)

Figure 5

Table 1

Table 12.1 Blackbody radiation functions[a]

Table 1

Table 12.1 Continued

λT $(\mu m \cdot K)$	$F_{(0 \to \lambda)}$	$I_{\lambda,b}(\lambda,T)/\sigma T^5$ $(\mu m \cdot K \cdot sr)^{-1}$	$\dfrac{I_{\lambda,b}(\lambda,T)}{I_{\lambda,b}(\lambda_{max},T)}$	λT $(\mu m \cdot K)$	$F_{(0 \to \lambda)}$	$I_{\lambda,b}(\lambda,T)/\sigma T^5$ $(\mu m \cdot K \cdot sr)^{-1}$	$\dfrac{I_{\lambda,b}(\lambda,T)}{I_{\lambda,b}(\lambda_{max},T)}$
200	0.000000	0.375034×10^{-27}	0.000000	7,000	0.808109	0.183534	0.254090
400	0.000000	0.490335×10^{-13}	0.000000	7,200	0.819217	0.170256×10^{-4}	0.235708
600	0.000000	0.104046×10^{-8}	0.000014	7,400	0.829527	0.158073	0.218842
800	0.000016	0.991126×10^{-7}	0.001372	7,600	0.839102	0.146891	0.203360
1,000	0.000321	0.118505×10^{-5}	0.016406	7,800	0.848005	0.136621	0.189143
1,200	0.002134	0.523927×10^{-5}	0.072534	8,000	0.856288	0.127185	0.176079
1,400	0.007790	0.134411×10^{-4}	0.185082	8,500	0.874608	0.106772×10^{-4}	0.147819
1,600	0.019718	0.249130	0.344904	9,000	0.890029	0.901463×10^{-5}	0.124801
1,800	0.039341	0.375568	0.519949	9,500	0.903085	0.765338	0.105956
2,000	0.066728	0.493432	0.683123	10,000	0.914199	0.653279	0.090442
2,200	0.100888	0.589649×10^{-4}	0.816329	10,500	0.923710	0.560522	0.077600
2,400	0.140256	0.658866	0.912155	11,000	0.931890	0.483321×10^{-5}	0.066913
2,600	0.183120	0.701292	0.970891	11,500	0.939959	0.418725	0.057970
2,800	0.227897	0.720239	0.997123	12,000	0.945098	0.364394	0.050448
2,898	0.250108	0.722318×10^{-4}	1.000000	13,000	0.955139	0.279457	0.038689
3,000	0.273232	0.720254×10^{-4}	0.997143	14,000	0.962898	0.217641	0.030131
3,200	0.318102	0.705974	0.977373	15,000	0.969981	0.171866×10^{-5}	0.023794
3,400	0.361735	0.681544	0.943551	16,000	0.973814	0.137429	0.019026
3,600	0.403607	0.650396	0.900429	18,000	0.980860	0.908240×10^{-6}	0.012574
3,800	0.443382	0.615225	0.851737	20,000	0.985602	0.623310	0.008629
4,000	0.480877	0.578064	0.800291	25,000	0.992215	0.276474	0.003828
4,200	0.516014	0.540394×10^{-4}	0.748139	30,000	0.995340	0.140469×10^{-6}	0.001945
4,400	0.548796	0.503253	0.696720	40,000	0.997967	0.473891×10^{-7}	0.000656
4,600	0.579280	0.467343	0.647004	50,000	0.998953	0.201605	0.000279
4,800	0.607559	0.433109	0.599610	75,000	0.999713	0.418597×10^{-8}	0.000058
5,000	0.633747	0.400813	0.554898	100,000	0.999905	0.135752	0.000019
5,200	0.658970	0.370580×10^{-4}	0.513043				
5,400	0.680360	0.342445	0.474092				
5,600	0.701046	0.316376	0.438002				
5,800	0.720158	0.292301	0.404671				
6,000	0.737818	0.270121	0.373965				
6,200	0.754140	0.249723×10^{-4}	0.345724				
6,400	0.769234	0.230985	0.319783				
6,600	0.783199	0.213786	0.295973				
6,800	0.796129	0.198008	0.274128				

[a]The radiation constants used to generate these blackbody functions
$C_1 = 3.7420 \times 10^8 \ \mu m^4/m^2$
$C_2 = 1.4388 \times 10^4 \ \mu m \cdot K$
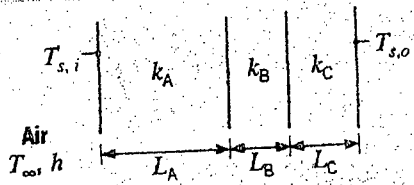$\sigma = 5.670 \times 10^{-8} \ W/m^2 \cdot K^4$.
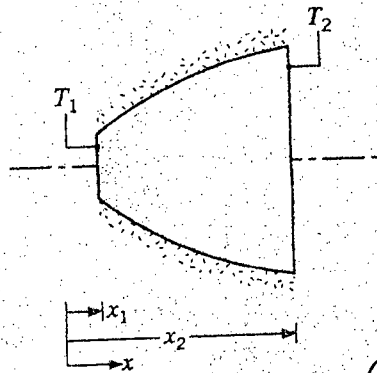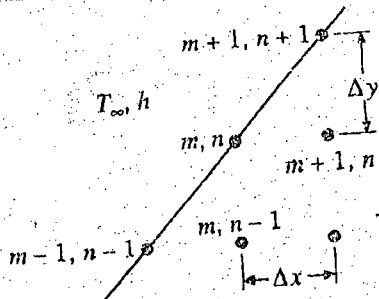
Fig. 6 for Q. No. 5(b)
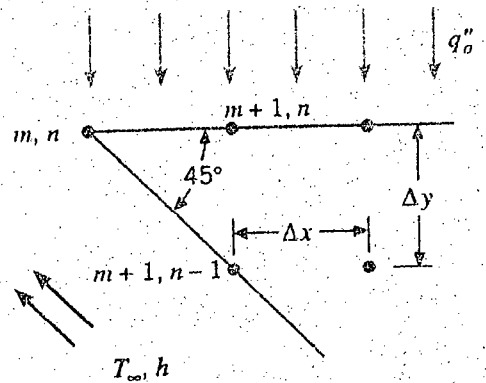

Fig. 7 for Q. No. 2(a)
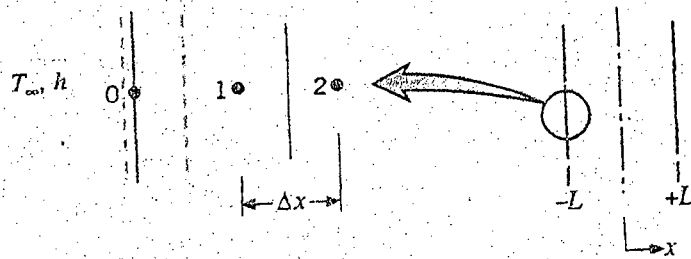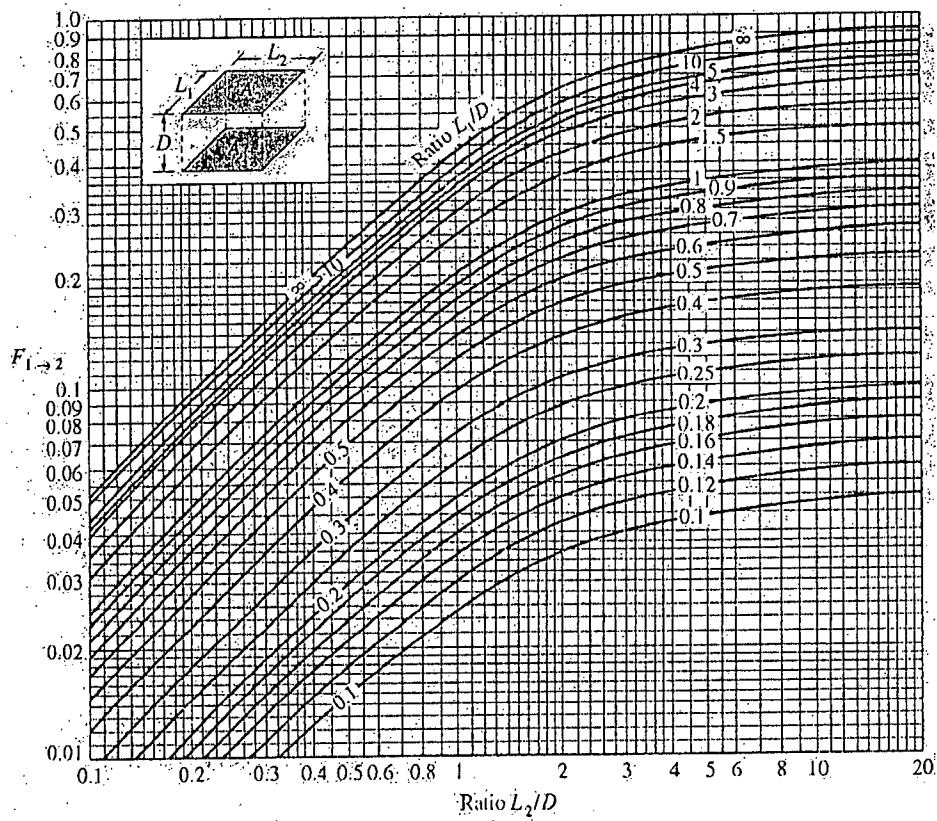

Fig. 8 for Q. No. 4(a)(i)

Fig. 9 for Q. No. 4(a)(ii)

Fig. 10 for Q. No. 4(b)

Ratio L_1/D

$F_{1\rightarrow2}$

Ratio L_2/D

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2   B. Sc. Engineering Examinations 2014-2015

Sub : **HUM 103** (Economics)

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**.

1. (a) Explain the short run equilibrium of a firm under perfect competition.   **(10)**

    (b) Define the concept of long run in the theory of production. How would you derive a
    long run average cost (LAC) curve of a firm from its short run cost curves?   **(10)**

    (c) What are the conditions of profit maximization?   **(5)**

    (d) Given the following total revenue (TR) and total cost (TC) functions for a firm   **(10)**

    $$TR = 4000Q - 33Q^2$$
    $$TC = 2Q^3 - 3Q^2 + 400Q + 5000$$

    where Q is quantity of output.

    (i) Set up the profit function.

    (ii) Find out the quantity which makes the profit maximum.

    (iii) Calculate the maximum profit and verify that it is maximized.

2. (a) Distinguish between the concepts of gross national product (GNP) and gross domestic
    product (GDP).   **(5)**

    (b) Explain the product method and income method of measuring national income.   **(10)**

    (c) Discuss the difficulties in the measurement of national income of a country like Bangladesh.   **(10)**

    (d) Calculate national income from the following information: **(10)**

    GNP = Tk. 1,18000 crore

    Depreciation = Tk. 10,000 crore

    Indirect tax = 13,000 crore

    Subsidy is 20% of indirect tax.

3. (a) Define inflation. What are the causes of inflation?   **(8)**

    (b) Explain monetary policy and fiscal policy for controlling the prevailing inflation in
    Bangladesh.   **(10)**

    (c) Explain the concept of economic development.   **(7)**

    (d) Show that the growth rate of a country is directly related to its savings – ratio and
    inversely related to its capital – output ratio.   **(10)**

HUM 103/MME

4. (a) Explain the operation of four wheels of growth in developing countries. **(10)**

   (b) Define investment. Discuss the various investment criteria for making an investment decision. **(15)**

   (c) State and prove the application of Euler's theorem in the theory of distribution of production. **(10)**

SECTION – B

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

Symbols indicate their usual meaning.

5. (a) How is a market demand curve derived? Distinguish between 'change in demand' and 'change in quantity demanded'. **(15)**

   (b) Explain the interactions between demand and supply schedules by which equilibrium price and quantity of a commodity are settled down in the open market economy. **(10)**

   (c) The demand and supply functions of an essential drug 'R-Tab' are respectively **(10)**

   $$Q_{DR} = 2380 - 32P_R$$

   $$Q_{SR} = 1455 + 25P_R$$

   Calculate the equilibrium price and output of the drug. If government provides a subsidy of Tk. 4.50 per unit, what will be the new equilibrium price and output of the drug?

6. (a) Define price elasticity and cross price elasticity of demand. Show the range of values of elasticity of demand with graphical presentations. **(15)**

   (b) From the following demand function **(10)**

   $$Q_d = 855 - 15P_A + 1.8\,P_B + 0.01\,M$$

   Where, price of the commodity A, P_A = Tk. 30, price of commodity B, P_B = Tk. 40 and income, M = 80,000. Find cross-price elasticity of commodity A and income elasticity.

   (c) Describe the basic determinants of elasticity of demand. **(10)**

7. (a) Narrate the stages of economic growth mentioned by Professor W.W. Rostow. **(15)**

   (b) What is meant by balanced growth? **(5)**

   (c) Discuss in detail the strategy of unbalanced growth with reference to a developing country like Bangladesh. **(15)**

8. Write short notes on any THREE of the following: **(35)**

   (i) The three basic economic problems that every economy has to face.

   (ii) Factors affecting supply of a commodity.

   (iii) Consumer equilibrium under ordinal theory of utility analysis.

   (iv) Substitution effect and income effect of a price change.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **HUM 303** (Principles of Accounting)

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**.

1. (a) According to revenue recognition principle when should the revenue record?   **(5)**

    (b) Mr. Khan started his manufacturing business on June 1, 2014. The following
    transaction took place during the month of operation: **(30)**

    June 1:   Invested Tk. 800,000 cash in the business.

    June 6:   Purchased office equipment in cash Tk. 120,000.

    June 10: Hired a managing director to manage the business efficiency. He will be
              paid Tk. 30,000 per month.

    June 12: Incurred advertising expenses on account Tk. 10,000.

    June 16: Incurred office rent in advance Tk. 15,000.

    June 17: Earned Tk. 80,000 for selling the product; Tk. 45,000 is received in cash and
              remaining on account.

    June 19: Withdrawn by Mr. Khna for his personal use Tk. 10,000 in cash from the
              business.

    June 20: Paid the amount due related to advertising expense.

    June 23: Received cash from previous customer related to transaction July 17.

    June 26: Employees salaries expense was due for Tk. 8,000.

    Required:

       (i) Prepare a tabular summary from the above transactions.

       (ii) Prepare an income statement.

2. (a) What are the advantages of using journal in the recording process?   **(5)**

    (b) Related information are available for "Z" Company for April, 2016–   **(18)**

    April 1:   Borrowed from bank Tk. 1000,000 cash by signing a note payable.

    April 4:   Paid utility expense of the month Tk. 1,000 in cash.

    April 6:   Purchase office equipment on account Tk. 60,000.

    April 11:   Received Tk. 50,000 cash from customers by providing services.

    April 17:   The owner withdrew Tk. 5,000 from the business.

    Required:

       (i) Necessary Journal Entries.

       (ii) Ledger accounts.

       (iii) A trial balance at April 30, 2016.

HUM 303/MME

Contd ... Q. No. 2

(c) Related financial information of "Marcel Refrigerator" is given below–   **(12)**

"Marcel Refrigerator"
Balance Sheet
December 31, 2014

	2014	2013
Cash	Tk. 5,200	Tk. 3,700
Accounts receivable	21,000	23,400
Inventory	10,000	7,000
Land	20,000	26,000
Building	70,000	70,000
Accumulated depreciation	(15,000)	(10,000)
Total	**111,200**	**120,100**
Accounts payable	13,070	31,100
Stockholder's equity:		
Common stock equity	75,000	69,000
Retained earnings	23,130	20,000
Total	**111,200**	**120,100**

Marcel 201 income statement included net sales of Tk. 100,000, cost of goods sold Tk. 60,000 and net income Tk. 15,000.

Required: Calculate the following ratios for 2014–

    (i) Current ratio

    (ii) Quick ratio

    (iii) Receivable turnover

    (iv) Inventory turnover

    (v) Profit margin

    (vi) Return on stock holder's equity

3. (a) Why is it possible to prepare financial statement directly from an adjusted trial balance?   **(5)**

(b) The trial balance of "Crescent Company" before adjustment at May 31, 2010 is given

below–   **(30)**

"Crescent Company"
Trial balance
May 31, 2010

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	3,500	
Supplies	2,200	
Prepaid insurance	2,280	
Land	12,000	
Machinery	60,000	

HUM 303/MME

Contd ... Q. No. 3(b)

Accounts Title	Debit (Tk.)	Credit (Tk.)
Furniture	15,000	
Accounts payable		4,800
Unearned rent		3,300
Bank loan		35,000
Capital		46,380
Rent revenue		10,300
Advertising expense	600	
Salaries expense	3,300	
Utility expense	900	
Total	**99,780**	**99,780**

Additional information:
> Prepaid insurance is a one year policy, starting from May 1, 2010.
> A count of supplies shows Tk. 750 of unused supplies on May 31, 2010.
> Annual depreciation is Tk. 3,000 on the machinery and Tk. 2,700 on furniture.
> The bank loan interest rate is 12%. (The bank loan was taken out on May 1)
> Unearned rent Tk. 2,500 has been earned.
> Salaries of Tk. 750 are accrued and unpaid at May 31.

Required:
(i) Journalize the adjusting entries on May 31.
(ii) Prepare an adjusted trial balance on May 31.

4. (a) Write down the classification of asset. **(5)**

(b) The following accounts are taken from the ledger balances of "M M fabrics"
Company on 31st December, 2011– **(30)**

"M M Fabrics"
Trial balance
31st December, 2011

Accounts Title	Debit (Tk.)	Credit (Tk.)
Accounts receivable	12,000	
Accounts payable		6,000
Cash	30,500	
MM Capital		50,900
Supplies	900	
Salaries expense	7,000	
Sales person salaries expense	3,000	
Inventory (31-12-2011)	4,000	
Rent expense	13,000	
Notes payable		5,000

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Contd ... Q. No. 4(b)

Accounts Title	Debit (Tk.)	Credit (Tk.)
Bonds payable		30,000
Store equipment	25,000	
Machinery	2,500	
Unearned commission		3,000
Sales		47,000
Cost of goods sold	30,000	
Prepaid insurance	4,000	
Trademark	10,000	
Total	141,900	141,900

Adjustments data:

(i) Charge 10% depreciation on store equipment.

(ii) 60% of rent expense relates to office and remaining to sales.

Required:

(i) Prepare a multiple step (classified) income statement for the year ended December, 2011.

(ii) Prepare an owner's equity statement and a classified balance sheet at 31st December, 2011.

SECTION – B

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

5. (a) Define the terms 'Relevant Cost' and 'Non-manufacturing Cost' with examples. **(5)**

(b) The following information has been taken from the accounting records of Enron Corporation for last year, 2015. **(30)**

Selling expenses	Tk. 140000
Raw material inventory, January 1	90000
Raw material inventory, December 31	60000
Utilities, factory	36000
Direct labor cost	150000
Depreciation, factory	162000
Purchase of raw materials	750000
Sales	2500000
Insurance, factory	40000
Supplies, factory	15000
Administrative expenses	270000
Indirect labor	300000
Maintenance, factory	87000
Work-in-process Inventory, Beginning	180000
Work-in-process Inventory, Ending	100000
Finished goods Inventory, Beginning	260000
Finished goods Inventory, Ending	210000

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Contd ... Q. No. 5(b)

Required:

(i) Prepare a schedule of cost of goods manufactured.

(ii) Prepare cost of goods sold statement.

(iii) Prepare an Income Statement.

6. (a) What are the differences between process costing and job-order costing? **(5)**

(b) Demston Corporation is a manufacturer that uses job-order costing. The company applies overhead cost to jobs on the basis of machine-hours worked. For the current year, the company estimated that it would work 75000 machine-hours and incur Tk. 450000 in manufacturing overhead cost. The following transactions were recorded for the year: **(30)**

• Raw materials were purchased on account Tk. 410000.

• Raw material were requisitioned for use in production Tk. 380000 (Tk. 360000 direct materials and Tk. 20000 indirect materials).

• The following cost were accrued for employee services: direct labor Tk. 75000, indirect labor Tk. 110000, sales commissions Tk. 90000 and administrative salaries Tk. 200000.

• Sales travel cost were Tk. 17000.

• Utility costs in the factory were Tk. 43000.

• Depreciation was recorded for the year Tk. 350000 (80% relates to factory operations and 20% relates to selling and administrative activities).

• Insurance expired during the year Tk. 10000 (70% relates to factory and 30% relates to administration).

• Manufacturing overhead was applied to production. The company worked 80000 machine-hours during the year.

• Goods costing Tk. 900000 to manufacturing according to the job cost sheets were completed.

Required:

(i) Prepare journal entries to record the preceding overhead.

(ii) Prepare the T-account of manufacturing overhead.

(iii) Is manufacturing overhead underapplied or overapplied for the year? Prepare a journal entry to close any balance in manufacturing overhead account to cost of goods sold.

7. (a) The admitting department's cost and the number of patients admitted to Nazim Hills Hospital during the immediately preceding eight months are given in the following table: **(15)**

Month	Number of Patients Admitted	Admitting department costs
May	1800	Tk. 14700
June	1900	15200
July	1700	13700
August	1600	14000
September	1500	14300
October	1300	13100
November	1100	12800
December	1500	14600

HUM 303/MME

Contd … Q. No. 7(a)

Required:

(i) Use the high-low method to establish the fixed and variable components of admitting costs.

(ii) Express the fixed and variable components of admitting costs as a cost formula in the form y = a + bx.

(b) Alif Company manufactures and sells a single product. The company's sales and expenses for last quarter are as follows: **(20)**

		Total	Per unit
Sales		Tk. 450000	Tk. 30
Less:	Variable expense	180000	12
	Contribution margin	270000	<u>18</u>
Less:	Fixed expenses	216000	
	Net Income	<u>54000</u>	

Required:

(i) What is the quarterly break-even-point in units sold and in sales amount?

(ii) Without restoring the computations, what is the total CM at the break-even point?

(iii) How many units would have to be sold each quarter to earn a target profit of Tk. 90000? Use the CM method.

(iv) Compute the company's margin of safety both in taka and percentage terms.

(v) What is the CM ratio? If sales increase by Tk. 50,000 per quarter and there is no change in the fixed expenses, by how much would you expect net income to increase?

8. (a) Xerox Computer Company has two support departments and two operating departments. Relevant information is given below: **(15)**

	Support Department		Operating Department		Total
	Legal Department	Personnel Department	Laptop Division	Work Station Division	
Budget manufacturing overhead cost	500000	100000	300000	200000	1100000
By Legal Department	---	1200	3200	4000	8400
Budgeted Legal hours					
By Personnel Department	400	---	1200	300	1900
Budgeted Personnel hours					

Required: Allocate support departmental cost to operating department by using:

(i) Direct method

(ii) Step-down method

HUM 303/MME

Contd ... Q. No. 8

(b) Write down the importance of capital budgeting decision. **(5)**

(c) A company is going to purchase a new machine. The related information of the machine is as follows: **(15)**

Cost of the machine	Tk. 75,000

Year	Net Profit After Tax (NPAT)
1	35000
2	12000
3	18000
4	10000
5	8000

Required: Calculate:—

(i) Pay Back Period

(ii) Internal Rate of Return

(iii) Net Present Value (NPV) at 10% cost of capital. Should the company buy the machine?

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2   B. Sc. Engineering Examinations 2014-2015

Sub : **MME 213** (Phase Diagrams and Transformations)

Full Marks : 280   .   Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **EIGHT** questions in this section. Answer any **SIX**.

1. During solidification of a single-phase alloy, describe the following limiting case for an alloy of composition X_0. Draw neat sketches of planar front solidification of alloy X_o and corresponding composition profile. Solidification with no diffusion in the solid but perfect mixing in the liquid. **(23⅓)**

2. During diffusional transformations in solids, describe heterogeneous nucleation of a phase at grain boundaries. Briefly discuss the shape of the nucleus at different locations of a grain such as *grain corner* and *grain edge*. **(23⅓)**

3. For an ideal solution, derive $J = -D\dfrac{dn_A}{dx}$, where all the terms have their usual meaning. **(23⅓)**

4. Discuss the satiation when cementite nucleates earlier than ferrite during eutectoid transformation of pearlite from austenite. Draw neat sketches if necessary. **(23⅓)**

5. What do you understand by spinodal transformation? Explain its differences with classical nucleation and growth by showing sequences of formation of two-phase mixture by diffusional processes. **(23⅓)**

6. (a) One step in manufacturing trenasistors, which function as electronic switches in integrated circuits, involves diffusing impurity atoms into a semiconductor material such as silicon (Si). Suppose a silicon wafer 0.1 cm thick, which originally contains one phosphorus atom for every 10 million Si atoms, is treated so that there are 400 phosphorous (P) atoms for every 10 million Si atoms at the surface. Calculate the concentration gradient in atoms.cm^{-3}.cm^{-1}. The lattice parameter of silicon is 5.4307Å. **(15)**

   (b) The Cu-Al alloy is an important precipitate-hardening alloy in which the alloy is solution treated in the α-shape field. Determine the time at 600 °C which is equivalent to 10 h heat treatment at 500 °C. Assume $D_{500\,C} = 4.1 \times 10^{-14}\, m^2\, s^{-1}$ and $D_{600\,C} = 4.7 \times 10^{-13}\, m^2\, s^{-1}$. **(8⅓)**

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7. (a) For dilute or ideal solutions, derive the driving force for precipitate nucleation $\Delta G_n = RT \ln \dfrac{X_o}{X_e}$ per mole of precipitate, where X_o and X_e are the mole fractions of solute and other terms have their usual meaning. **(15)**

(b) In the above mentioned solution condition, assuming β is pure solute $X_B^\beta = 1$, **(8⅓)**

   (i) Evaluate ΔG_n for the precipitate.

   (ii) What will be the critical nucleus radius during homogeneous nucleation?

Property Data: $\gamma = 200 \; mJ \, m^{-2}$, $V_m = 10^{-5} \, m^3$, $X_o = 0.1$ and $X_e = 0.02$

8. Draw sketches of different types of interfaces of particles and matrices based on coherency, and discuss how coherency of particles affect precipitation hardening. **(23⅓)**

SECTION – B

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

9. (a) Explain why complete mutual solubility can occur between the twp components of a substitutional solid solution but not for an interstitial solid solution. **(10)**

(b) What are phase diagrams? Explain the importance of phase diagrams in the development of new alloys. What are the limitations of these diagrams? **(10)**

(c) Bismuth and antimony are completely soluble in both the liquid and solid states. Bismuth melts at 271°C and antimony melts at 632°C. An alloy containing 50 percent bismuth starts to solidify at 505°C by separating crystals of 90 percent antimony. An alloy containing 80 percent bismuth starts to solidify at 400°C by separating crystals of 75 percent antimony. **(26⅔)**

Draw the equilibrium diagram to scale on a piece of graph paper labeling all points, lines and areas. For an alloy containing 40 percent antimony determine:

   (i) the temperature of initial and final solidification

   (ii) the chemical composition and relative amounts of the phases present at 30°C below initial solidification temperature.

10. (a) What is meant by a peritectic reaction? Sketch an equilibrium diagram of a system containing such a reaction and describe the equilibrium cooling of two typical alloys, at least one of which undergoes a peritectic reaction. **(23)**

MME 213

(b) With reference to a hypothetical equilibrium diagram, describe how coring occurs during solidification, under normal conditions, of a solid solution alloy. Describe how coring is prevented or removed by **(23⅔)**

    (i) cooling under equilibrium conditions and

    (ii) annealing after normal solidification.

11. (a) What is meant by eutectic shift? How does it take place? **(10)**

    (b) Explain, with a suitable phase diagram, an order-disorder reaction. **(15)**

    (c) Outline the problem and principles of interpretation of complex phase diagrams. **(21⅔)**

12. (a) Name the three allotropic forms of iron and indicate the lattice structure of each. Upon heating, pure iron has an allotropic transformation at 910°C. Does iron expand, contract or retain its original volume during this transformation? **(10)**

    (b) How are the critical temperatures in steel designated? What is meant by critical temperature range? How is this related to heating and cooling? **(10)**

    (c) A 1.10 percent carbon steel is slowly cooled from 950°C to a temperature just above 723°C. Calculate the relative amounts of each microconstituent present in the steel. **(26⅔)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2   B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 267** (Electrical and Electronic Technology)

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**.

1. (a) Draw the energy-band diagram of a p-n junction under forward and reverse bias condition.   **(10)**

(b) Consider the circuit shown in Fig. for Q. 1(b)(ii) , the power supply V+ has a waveshape shown in Fig. for Q. (b)(i), calculate both the DC voltage of the diode and amplitude of the sine-wave signal appearing across it. Assume the diode have a 0.7 V drop at 1 mA current. Also draw small-signal equivalent circuit.   **(13)**

fig for Q 1 (b)
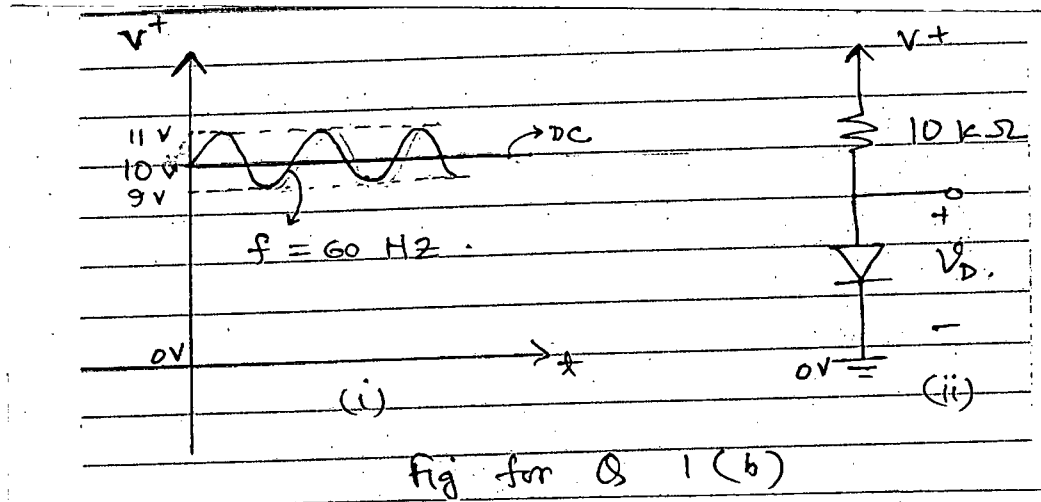
(c) Explain the operation of full bridge rectifier circuit with neat sketch of circuit diagram and input/output waveshape. Also draw the waveshape if a capacitor is added parallel to the load.   **(12)**

2. (a) In which mode should a BJT be operated to obtain linear amplification? Explain with necessary graphs. Also find the expression for gain and theoretical maximum gain.   **(15)**

(b) Find the node voltages and branch currents of the circuit shown in Fig. for Q. 2(a) (i) and (ii). Assume $\beta = 100$.   **(20)**

fig for Q 2(b)
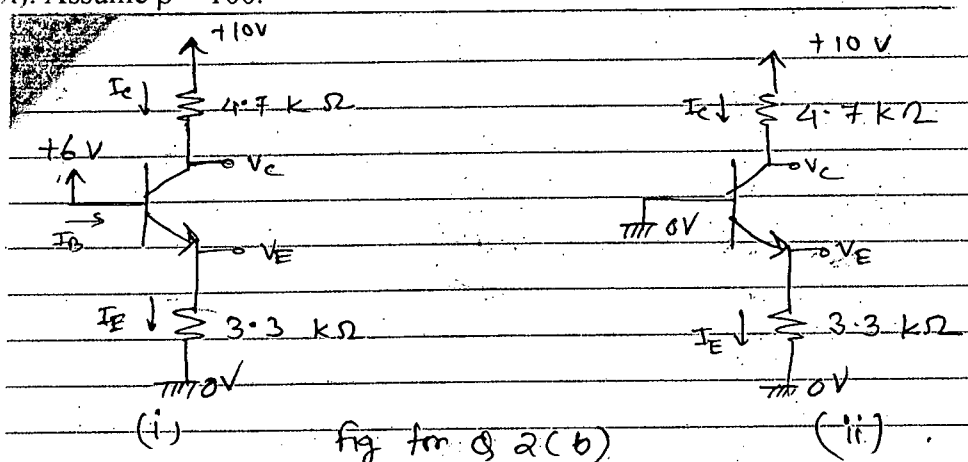
3. (a) A 480 V, 60 Hz, 50 HP, 3 ϕ induction motor is drawing 60 A at 0.85 p.f (lagging). The stator copper losses are 2 kW, Rotor coppers losses are 700 W. The friction and windage losses are 600 W, core losses are 1800 W. Find the following neglecting stray loss: **(17)**

    (i) Air gap power

    (ii) The power converted

    (iii) The output power

    (iv) The efficiency of motor

Also draw the corresponding power flow diagram.

(b) A 208-V, two pole, 60 Hz, Y-connected induction motor is rated at 15 HP. Its equivalent circuit components are (per phase): **(18)**

    $R_1 = 0.2\ \Omega$ $X_1 = 0.410\ \Omega$

    $R_2 = 0.120\ \Omega$ $X_2 = 0.410\ \Omega$

    $X_M = 15\ \Omega$

    $P_{mesh} = 250$

    $P_{core} = 180$ and ignore other losses.

For a slip of 5% find:

    (i) Line current

    (ii) P_{SCL}

    (iii) P_{AG}

    (iv) P_{CONV}

    (v) τ_{load}

    (vi) Overall efficiency

4. (a) Show that, a balanced three-phase set of current flowing through a 3-ϕ winding produces a rotating magnetic field of constant magnitude. How can the direction of rotation of magnetic field can be reversed. **(15)**

(b) What are the advantages of parallel operation of synchronous generator? Write down the condition for parallel operation of two synchronous generator. **(10)**

(c) What is piezoelectricity? How the piezoelectric effect work? Write down some of the application of piezoelectric effect. **(10)**

SECTION – B

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

5. (a) A 20-kVA, 20,000/480 V, 60 Hz distribution transformer is tested with the following results: **(20)**

| Open-circuit test (measures from low-voltage side)	Short-circuit test (measures from high-voltage side)
$V_{OC} = 480$ V	$V_{SC} = 1130$ V
$I_{OC} = 1.60$ A	$I_{SC} = 1.00$ A
$P_{OC} = 305$ W	$P_{SC} = 260$ W

(i) Find the equivalent circuit of this transformer referred to low-voltage side.

(ii) Calculate the full-load voltage regulation at 0.8 lagging power factor.

(iii) What is the efficiency of the transformer at full load with a power factor of 0.8 lagging?

(b) Explain how the leakage flux and core excitation effects in a transformer can be modeled with necessary equations and waveforms. **(15)**

6. (a) Derive the torque-speed characteristic of a shunt DC motor. **(10)**

(b) Explain what happens when the field resistor of a dc motor is decreased. **(7)**

(c) A 240 V, 1800 r/min shunt DC motor is operating at base speed with rated field current. A specific application requires the motor speed to be changed to 1650 r/min. Explain which method of speed control should be used and why. **(6)**

(d) A 50-hp, 250 V, 1200 r/min dc shunt motor with compensating windings has an armature resistance of 0.06 Ω. The field circuit has a total resistance $R_{adj} + R_F$ of 50 Ω, which produces a no-load speed of 1200 r/min. Find the speed of this motor when its input current is 200 A. What is the induced torque at this condition? **(12)**

7. (a) Describe the probable causes for the voltage to fail to build-up during starting of a dc shunt generator. What are the solutions to this problem? **(15)**

(b) A separately excited dc generator is rated at 172 kW, 430 V, 400 A and 1800 r/min. Its magnetization curve is shown in Fig. for Q. No. 7(b). This machine has the following characteristics: **(4+6+10)**

$R_A = 0.05$ Ω $V_F = 430$ V

$R_F = 20$ Ω $N_F = 1000$ turns per pole

$R_{adj} = 0$ to 300 Ω

(i) If the variable resistor R_{adj} in this generator's field circuit is adjusted to 63 Ω and the generator's prime mover is driving at 1600 r/min, what is the generator's no load terminal voltage?

(ii) What would its voltage be if a 360 A load were connected to its terminals and the generator does not have compensating windings? Assume that its armature reaction at this load is 450 A turn.

(iii) What would its voltage be if a 360 A load were connected to its terminals and the generator has compensating windings? How much field current would be needed to restore the terminal voltage to its no-load value? What is the required value for the resistor R_{adj} to accomplish this?

EEE 267/MME

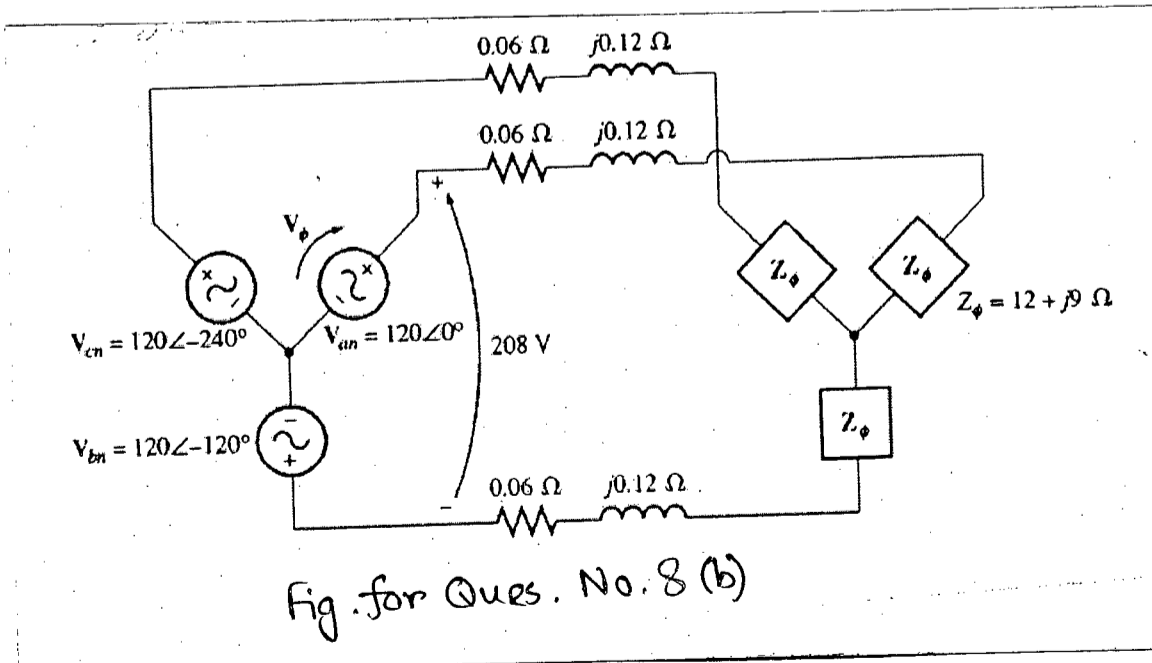**Contd ... Q No. 7(b)**
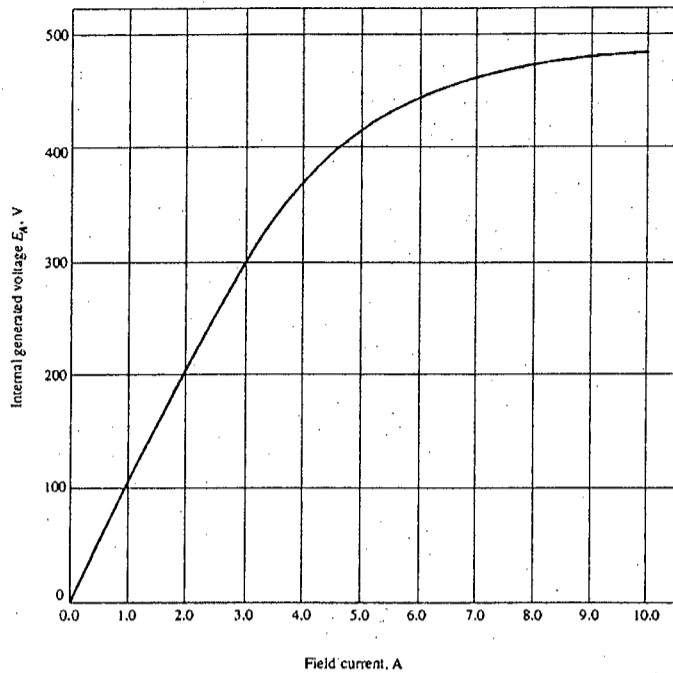
Field current, A

Note: When the field current is zero, E_A is about 3 V.

Fig. for Ques. No. 7(b)

8. (a) Define voltage regulation of a transformer. How does the power factor of a load affect the voltage regulation? Explain with the help of phasor diagrams. **(15)**

(b) A 208-V three phase power system is shown in Fig. for Q. No. 8(b). It consists of an ideal 208 V Y connected three phase generator connected through a three phase transmission line to a Y-connected load. The transmission line has an impedance of 0.06 + j0.12 Ω per phase, and the load has an impedance of 12 + j9 Ω per phase. For this power system, find – **(20)**

    (i) The magnitude of the line current I_L.

    (ii) The magnitude of the load's line and phase voltages V_{LL} and $V_{\Phi L}$.

    (iii) The real, reactive and apparent powers consumed by the load.

    (iv) The power factor of the load.

    (v) The real, reactive and apparent powers consumed by the transmission line.

    (vi) The real, reactive and apparent powers supplied by the generator.

    (vii) The generator's power factor.

Fig. for Ques. No. 8 (b)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2   B. Sc. Engineering Examinations 2014-2015

Sub : **ME 221** (Elements of Fluid Mechanics and Machinery)

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**.

Assume any data if necessary. Symbols used have their usual meaning.

1. (a) With proper assumptions, derive the Hagen-Poiseuille equation for fluid flow. What is the physical significance of the equation?   **(15)**

   (b) Water is flowing from a reservoir at the rate of 30 l/s through a 1000 m long and 150 mm diameter commercial steel pipe ($\varepsilon = 0.046$ mm) into the chamber B where the pressure is 40 kPa. Find the pressure P_1. The kinematic viscosity of water is 1.02×10^{-6} m^2/s.   **(20)**

Figure for Q 1(b)

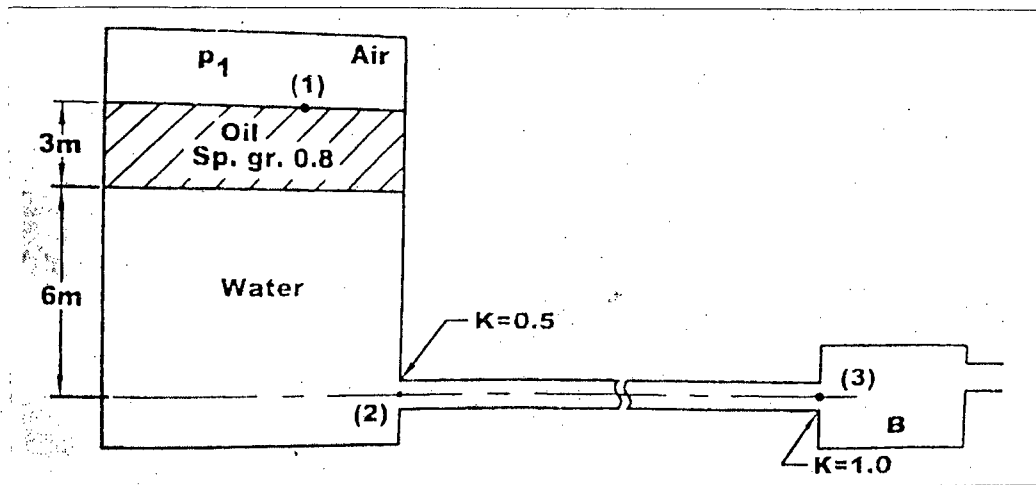
2. (a) What do you mean by 'streamtube'? With neat sketch, deduce the Continuity Equation for steady flow.   **(20)**

   (b) Water is pumped at the rate of 75 l/s through the piping system as shown in Fig. Q 2(b). The pump absorb 8 kW power and the pressure at the point A is 200 mm of Hg vacuum. Find the pressure at point B. Neglect any losses.   **(15)**
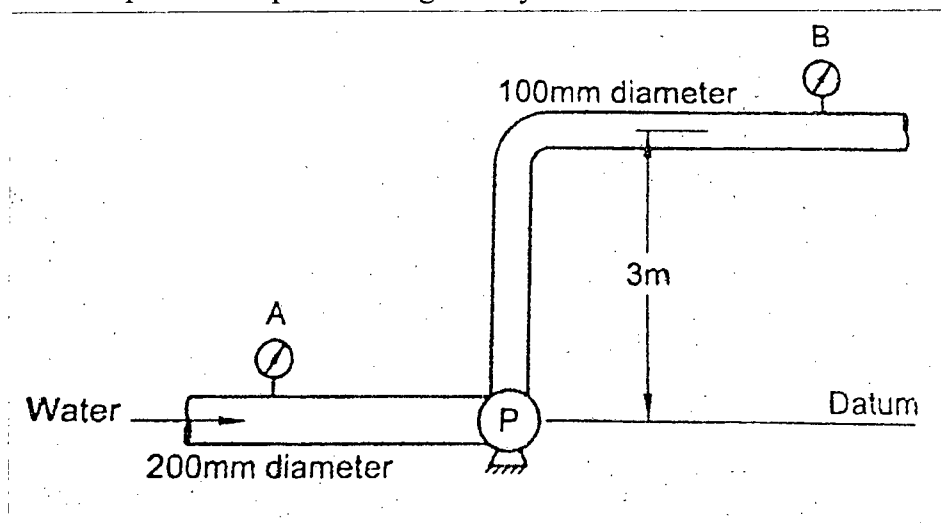

Figure : Q2(b)

ME 221/MME

3. (a) Discuss the effect of variation of pressure due to the acceleration of piston in a reciprocating pump. **(15)**

(b) Draw the indicator diagram of a reciprocating pump considering both acceleration head and frictional losses. **(5)**

(c) Calculate the diameter of circular open channel which is laid at a slope of 1 in 7500 and carries water at the rate if 0.90 cumec, when flowing half full. Take the value of Manning's constant, N = 0.025. **(15)**

4. (a) Why priming is necessary for a centrifugal pump? **(5)**

(b) Sketch the typical performance curves for a centrifugal pump. **(5)**

(c) Explain NPSH of a centrifugal pump. **(5)**

(d) The outside diameter and outside width of each impeller of a three stage centrifugal pump are 425 mm and 20 mm respectively. The vanes are curved back at outlet at 45° and reduce the outlet area by 7%. The manometric and overall efficiencies are 86% and 76% respectively. The pump delivers 60 l/s of water at 1000 rpm. Determine the manometric head and the power required to drive the pump. **(20)**
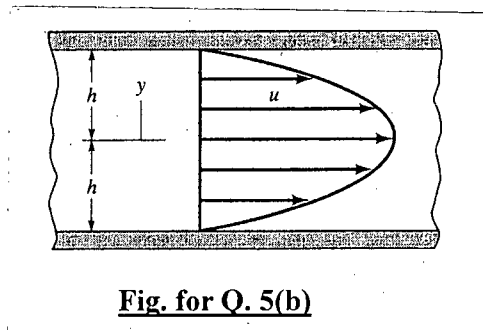
SECTION – B
There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Mention the names of at least five properties of fluids. How can you differentiate between Newtonian and non-Newtonian fluids? Give some examples of non-Newtonian fluids. **(10)**

(b) The velocity distribution for the flow of Newtonian fluid between two fixed wide, parallel plates (shown in Fig. for Q. 5(b)) is given by the following expression– **(15)**

$$u = \frac{3V}{2}\left[1 - \left(\frac{y}{h}\right)^2\right]$$

where V is the mean velocity. The fluid has a viscosity of 1.2×10^{-3} Pa.s. Also $V = 2$ m/s and $h = 10$ mm. Determine–

    (i) the shear stress acting on the bottom wall and

   (ii) the shear stress acting on a plane parallel to the walls and passing through the centerline.

Fig. for Q. 5(b)

(c) Show that-pressure at a given point acts equally in all directions in a static fluid. **(10)**

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6. (a) What do you mean by the stability of a submerged body? Discuss in brief. A wooden block of relative density 0.70 is 2.0 m × 2.0 m in plane and 1.0 m deep. Determine its metacentric height when it floats in water. **(15)**

(b) Compartment A and B of the tank shown in Fig. for Q. 6(b) are closed filled with air and a liquid with a specific gravity (SG) of 0.6. Determine the manometer reading, h, if the barometric pressure is 101.3 kPa and the pressure gage reads 3.5 kPa. The effect of the weight of the air is negligible. **(20)**

Fig. for Q. 6 (b)
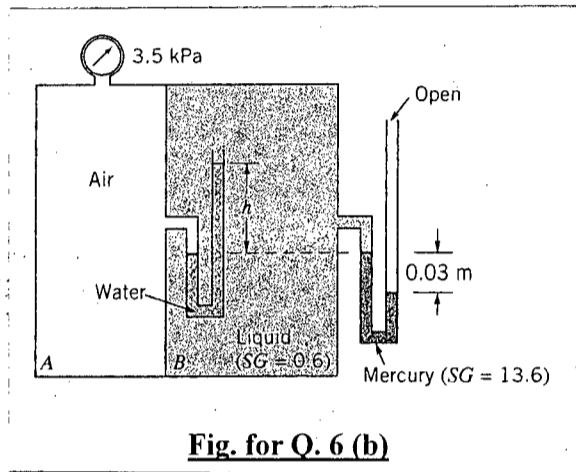
7. (a) Consider a plane surface immersed in a liquid at a depth of h and at an angle of θ with the free-surface. Determine the location of center of pressure (CP) due to hydrostatic force acting on this plane surface. **(15)**

(b) The 4 m diameter circular gate as shown in Fig. for Q. 7(b) is located in the inclined wall of a large reservoir containing water (γ = 9.80 kN/m^3). The gate is mounted on a shaft along its horizontal diameter, and the depth of 10 m above the shaft. Determine– **(20)**

   (i) the magnitude and location of the resultant force exerted on the gate by the water.

   (ii) the moment that would have to be applied to the shaft to open the gate.
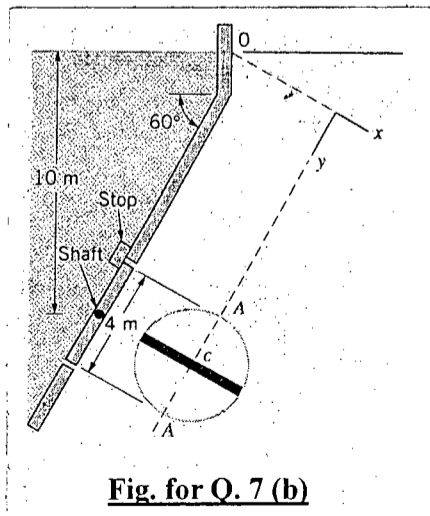
Fig. for Q. 7 (b)

ME 221/MME

8. (a) What do you mean by the "coefficient of discharge"? Derive an expression of actual flow rate through a venturimeter. **(20)**

(b) A piston having a cross-sectional area of 0.09 m^2 is located in a cylinder water as shown in Fig. for Q. 8(b). An open U-tube manometer is connected to the cylinder as shown in figure. For h_1 = 60 mm and h = 100 mm, what is the value of the applied force, P acting on the piston? The weight of the piston is 5 kg. **(15)**

Fig. for Q. 8 (b)

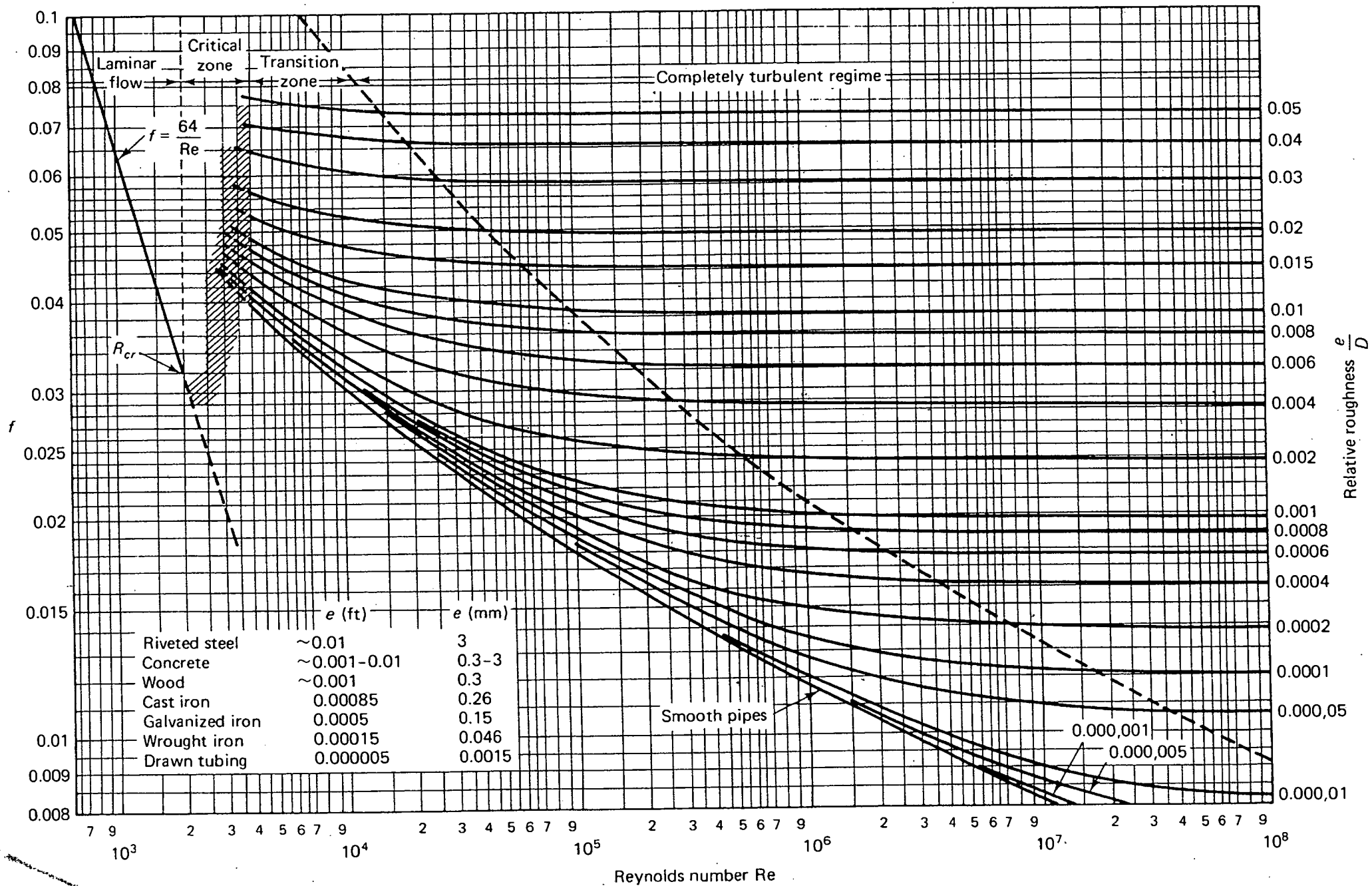---
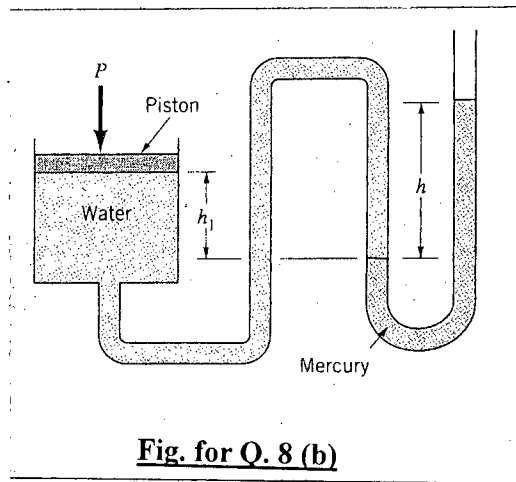
Figure 7.13 Moody diagram. (From L. F. Moody, *Trans. ASME*, Vol. 66, 1944.)

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δ = 5 =