L-2/T-2/ MME

Date: 09/01/2021

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B.Sc. Engineering Examination 2018-2019

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

Full Marks: 240 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

## SECTION-A

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

1. (a) Draw an iron-iron carbide equilibrium phase diagram and level all phases on it with relevant compositions and temperatures. **(25)**

   (b) For an alloy containing 0.6 wt.% C steel, show that total ferrite content equals to the sum of pro-eutectoid ferrite and eutectoid ferrite. **(15)**

2. (a) Why studying ternary diagram is very import to study the structure of alloys? Draw a vertical section of a ternary phase diagram showing complete solid-state insolubility where section will pass through melting point of a pure element and a binary eutectic point. **(20)**

   (b) Consider a ternary diagram for the pure metals A, B and C. Melting temperature of A, B and C are $850^0$ C, $750^0$ C and $500^0$ C, respectively. Eutectic temperature for A and B is $600^0$ C, for B and C is $400^0$ C and for A and C is $300^0$ C. Draw isothermal sections at temperature $650^0$ C, $550^0$ C, $450^0$ C and $200^0$ C. **(20)**

3. (a) Describe the relation of free energy curves and stability of phases. **(15)**

   (b) For a binary diagram, which exhibits partial solid solubility, draw all the free energy curves that shows stability of different phases at different temperatures. **(25)**

4. (a) On a CCT diagram, draw critical cooling curves that produce (i) 100% coarse pearlite, (ii) 50% fine pearlite and 50% bainite and (iii) 50% bainite and 50% martensite. **(15)**

   (b) With neat sketches and short description, distinguish between the ordered structures of AuCu and $Au_3Cu$. **(25)**

**Contd. ... P/2**

## SECTION-B

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

*For drawing phase diagrams in questions, assume standard practice.*

5. a) For a hypothetical multi-component alloy system of solid solution, draw a schematic yield stress vs alloying element amount (wt.%) plot for four different alloying elements: A, B, C & D. Among these four elements, the slope of the curve is very steep for the behaviour of elements A & B, and quite flat for C & D. Provide your judgement on different behaviour of these elements for yield stress of the alloy. You should use schematic diagrams while assessing your argument. **(20)**

(b) A system having 1, 2, 3 or 0 degrees of freedom is called univariant, bivariant, trivariant and nonvariant respectively. Now consider pressure–temperature phase diagram for $H_2O$ (Figure 1). Apply the Gibbs phase rule at points A, B, and C. Calculate the number of externally controllable variables that need to be specified to completely define the system at each point. **(20)**

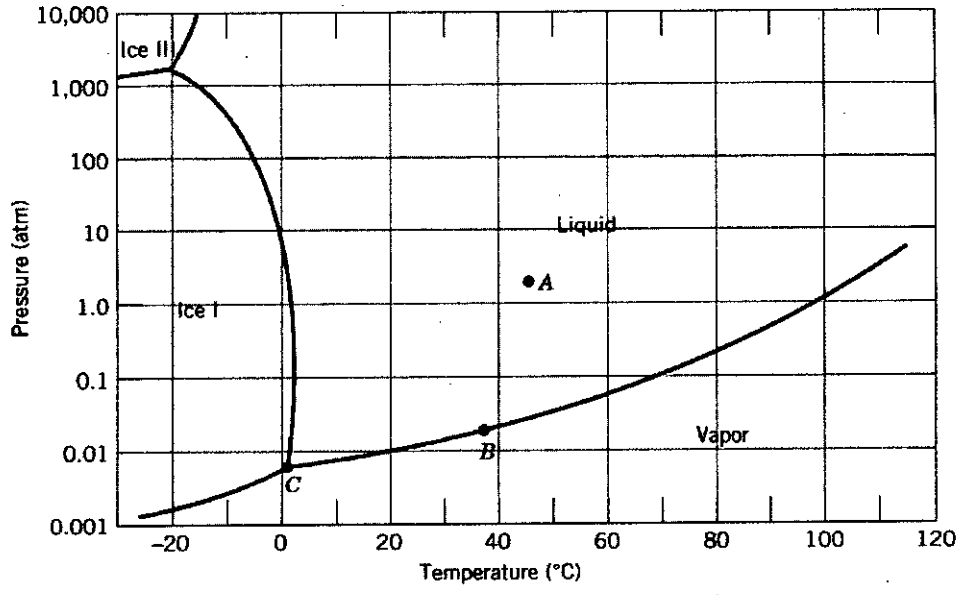



**Figure 1 for Question No. 5(b)**

**MME 213**

6. (a) Draw a schematic isomorphous phase diagram of a binary system A and B. What are the reasons for existence of liquidus lines and solidus lines? In which regions of the diagram, solid and liquid phase composition changes during cooling? What are the reasons for such behaviour? **(5+5+5+5)**

   (b) Is it possible to obtain different microstructures during equilibrium cooling and non-equilibrium cooling for a hypothetical isomorphous alloy system of A and B? Explain the reasons in terms of phase diagram. **(20)**

7. (a) What are the major differences between congruent and incongruent phase transformations? **(10)**

   (b) Draw a hypothetical binary eutectic phase diagram for elements A and B. Now, identify three alloys: one crossing the solvus line, one in the hypoeutectic region and another one in the hypereutectic region. Draw schematic microstructure at room temperature for these three alloys. Are there any differences in phases or in microstructures? Apply your judgement to critically discuss your statement. **(5+5+10+20)**

8. (a) What are the reasons for formation of lamellar structure in a eutectic phase? **(10)**

   (b) In the hypothetical phase diagram containing peritectic reaction(s), as shown in Figure 2, there are three different alloy compositions: Alloy 1, Alloy 2 and Alloy 3. Just below the peritectic reaction line: in Alloy 1, only β phase is present; in Alloy 2, mostly σ and some β phases are present; in Alloy 3, some β and mostly liquid phases are present. In each case, draw all relevant microstructures during cooling from liquid to below T4 temperature and explain the role of liquid in obtaining different amounts of β. **(30)**

**Contd. ... P/4**

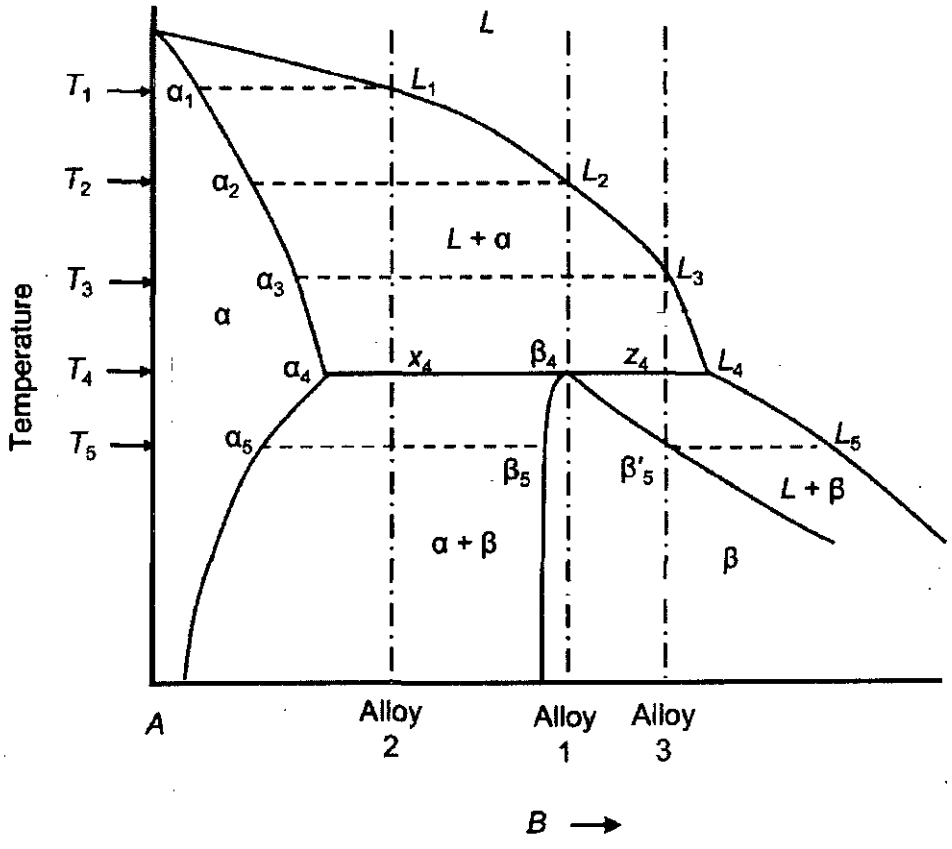



**Figure 2 for Question No. 8(a)**

L-2/T-2/ MME

Date: 23/01/2021

BANGLADESHUNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B.Sc. Engineering Examination 2018-2019

Sub: **MME 235** (Heat and Mass Transfer)

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

## SECTION-A

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

Table for Blackbody Radiation Function and Figure for View Factor is provided.

Symbols have their usual meanings. Assume reasonable values for any missing data.

1. (a) 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, $Re_{x,c} = 5 \times 10^5$. For air at T = 350 K: k = 0.030 W/m·K, $\rho$ = 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 unit of m.
Develop an expression for the average convection coefficient, as a function of distance from the leading edge, $x$, for the laminar region, $0 \le x \le x_c$.

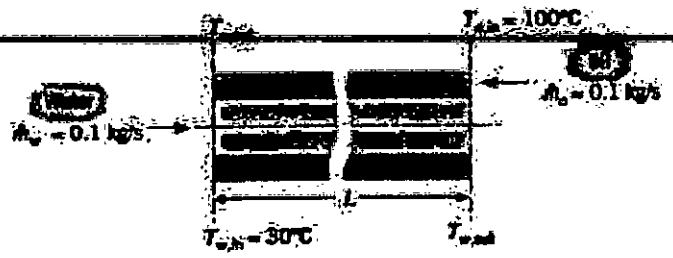
iii) Develop an expression for the average convection coefficient, as a function of distance from the leading edge, $x$, for the turbulent region, $x_c \le x \le L$. **(20)**

(b) Species A is evaporating from a flat surface into species B. Assume that the concentration profile for species A in the concentration boundary layer is of the form $C_A(y) = Dy^2 + Ey + F$, where D, E, and F are constants at any x-location and y is measured along a normal from the surface. Develop an expression for the mass transfer convection coefficient $h_m$ in terms of these constants, the concentration of A in the free stream $C_{A,\infty}$ and the mass diffusivity $D_{AB}$. **(10)**

2. (a) A concentric tube heat exchanger for cooling lubricating oil is comprised of a thin-walled inner tube of 25-mm diameter carrying water and an outer tube of 45-mm diameter carrying oil. The exchanger operates in counter flow with an overall heat transfer coefficient of 60 W/ m$^2$·K and the tabulated average properties.

i) If the outlet temperature of the oil is 60°C, determine the total heat transfer and the outlet temperature of the water.

ii) Determine the length required for the heat exchanger. **(20)**



| Properties | Water | Oil |
|---|---|---|
| $\rho$ (kg/m$^3$) | 1000 | 800 |
| $c_p$ (J/kg·K) | 4200 | 1900 |
| $\nu$ (m$^2$/s) | $7 \times 10^{-7}$ | $1 \times 10^{-5}$ |
| $k$ (W/m·K) | 0.64 | 0.134 |
| Pr | 4.7 | 140 |

(b) What can be said about the change in temperature of a saturated fluid undergoing evaporation or condensation in a heat exchanger? **(10)**

3. (a) Differentiate between: i) spectral and total radiation;
ii) directional and hemispherical radiation. **(10)**

(b) The spectral transmissivity of plain and tinted glass can be approximated as follows: Plain glass: $\tau_A = 0.9$ for $0.3 \leq \lambda \leq 2.5$ $\mu$m; Tinted glass: $\tau_B = 0.9$ for $0.5 \leq \lambda \leq 1.5$ $\mu$m. Outside the specified wavelength ranges, both glasses are opaque to radiation. Compare the solar energy that could be transmitted through the glasses. **(20)**

4. (a) Determine the view factor $F_{14}$ for the configuration shown in Figure 4(a). **(20)**

Figure: 4(a)

(b) How is the geometrical resistance associated with radiative exchange between two surfaces of an enclosure defined? What is the driving potential that relates this resistance to the net rate of radiation transfer between the surfaces? **(10)**

## SECTION-B

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

5. (a) Convection ovens operate on the principle of inducing forced convection inside the oven chamber with a fan. A small cake is to be baked in an oven when the convection feature is disabled. For this situation, the free convection coefficient associated with the cake and its pan is $h_{fr} = 3\ W/m^2.K$. The oven air and wall are at temperatures $T_\infty = T_{sur} = 180^oC$. Determine the heat flux delivered to the cake pan and cake batter when they are initially inserted into the oven and are at a temperature of $T_i = 24^oC$. If the convection feature is activated, the forced convection heat transfer coefficient is $h_{fo} = 27\ W/m^2.K$. What is the heat flux at the batter or pan surface when the oven is operated in the convection mode? Assume a value of 0.97 for the emissivity of the cake batter and pan. **(15)**

   (b) An electric resistance heater is embedded in a long cylinder of diameter 30 mm. When water with a temperature of 25°C and velocity of 1 m/s flows crosswise over the cylinder, the power per unit length required to maintain the surface at a uniform temperature of 90°C is 28 kW/m. When air, also at 25°C, but with a velocity of 10 m/s is flowing, the power per unit length required to maintain the same surface temperature is 400 W/m. Calculate and compare the convection coefficients for the flows of water and air. **(15)**

6. (a) Mention the boundary conditions commonly encountered in heat transfer and explain the situations they correspond to. **(13)**

   (b) A spherical shell of inner and outer radii $r_i$ and $r_o$ respectively, contains heat-dissipating components, and at a particular instant the temperature distribution in the shell is known to be of the form

$$T(r) = \frac{C_1}{r} + C_2$$

   Are the conditions steady-state or transient? How do the heat flux and heat rate vary with radius? **(17)**

7. (a) Two stainless steel plates of 10 mm thickness are subjected to a contact pressure of 1bar under vacuum conditions for which there is an overall temperature drop of 100°C across the plates. What is the heat flux through the plates? What is the temperature drop across the contact plane?
   [Use these values: $k = 16.6\ W/m.K$, $R''_{t,c} \approx 15 \times 10^{-4}\ m^2.K/W$ ] **(15)**

   (b) An uninsulated, thin-walled pipe of 100-mm diameter is used to transport water to equipment that operates outdoors and uses the water as a coolant. During particularly harsh winter conditions, the pipe wall achieves a temperature of –15°C and a cylindrical layer of ice forms on the inner surface of the wall. If the mean water temperature is 3°C and a convection coefficient of 2000 $W/m^2.K$ is maintained at the inner surface of the ice, which is at 0°C, what is the thickness of the ice layer?
   [ Consider : $k \approx 1.94\ W/m.K$] **(15)**

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. 8a(i)) subjected to convection with a fluid at $T_\infty$ and a heat transfer coefficient h. Assume $\Delta x = \Delta y$. **(10)**

ii) Node (m, n) at the tip of a cutting tool (Fig. 8a(ii)) with the upper surface exposed to a constant heat flux $q_o''$ and the diagonal surface exposed to a convection cooling process with the fluid at $T_\infty$ and a heat transfer coefficient h. Assume $\Delta x = \Delta y$. **(10)**

(b) Consider the nodal point '0' located on the boundary (Fig. 8b) between materials of thermal conductivity $k_A$ and $k_B$. Derive the finite-difference equation, assuming no internal generation. **(10)**

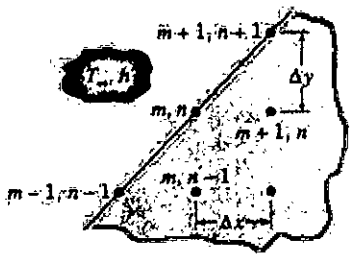



Fig. 8a(i)

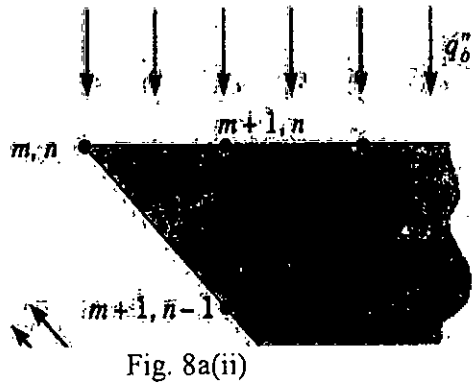



Fig. 8a(ii)

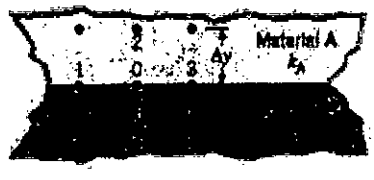



Fig. 8b

Table: Blackbody Radiation Function

| $\lambda T$ ($\mu m \cdot K$) | $F_{(0 \to \lambda)}$ | $I_{\lambda,b}(\lambda,T)/\sigma T^5$ ($\mu m \cdot K \cdot sr)^{-1}$ | $\frac{I_{\lambda,b}(\lambda,T)}{I_{\lambda,b}(\lambda_{max},T)}$ |
|---|---|---|---|
| 200 | 0.000000 | $0.375034 \times 10^{-27}$ | 0.000000 |
| 400 | 0.000000 | $0.490335 \times 10^{-13}$ | 0.000000 |
| 600 | 0.000000 | $0.104046 \times 10^{-8}$ | 0.000014 |
| 800 | 0.000016 | $0.991126 \times 10^{-7}$ | 0.001372 |
| 1,000 | 0.000321 | $0.118505 \times 10^{-5}$ | 0.016406 |
| 1,200 | 0.002134 | $0.523927 \times 10^{-5}$ | 0.072534 |
| 1,400 | 0.007790 | $0.134411 \times 10^{-4}$ | 0.186082 |
| 1,600 | 0.019718 | 0.249130 | 0.344904 |
| 1,800 | 0.039341 | 0.375568 | 0.519949 |
| 2,000 | 0.066728 | 0.493432 | 0.683123 |
| 2,200 | 0.100888 | $0.589649 \times 10^{-4}$ | 0.816329 |
| 2,400 | 0.140256 | 0.658866 | 0.912155 |
| 2,600 | 0.183120 | 0.701292 | 0.970891 |
| 2,800 | 0.227897 | 0.720239 | 0.997123 |
| 2,898 | 0.250108 | $0.722318 \times 10^{-4}$ | 1.000000 |

Table: Blackbody Radiation Function (Continued)

| $\lambda T$ ($\mu$m · K) | $F_{(0 \to \lambda)}$ | $I_{\lambda,b}(\lambda, T)/\sigma T^5$ ($\mu$m · K · sr)$^{-1}$ |
|---|---|---|
| 3,000 | 0.273232 | $0.720254 \times 10^{-4}$ |
| 3,200 | 0.318102 | 0.705974 |
| 3,400 | 0.361735 | 0.681544 |
| 3,600 | 0.403607 | 0.650396 |
| 3,800 | 0.443382 | $0.615225 \times 10^{-4}$ |
| 4,000 | 0.480877 | 0.578064 |
| 4,200 | 0.516014 | 0.540394 |
| 4,400 | 0.548796 | 0.503253 |
| 4,600 | 0.579280 | 0.467343 |
| 4,800 | 0.607559 | 0.433109 |
| 5,000 | 0.633747 | 0.400813 |
| 5,200 | 0.658970 | $0.370580 \times 10^{-4}$ |
| 5,400 | 0.680360 | 0.342445 |
| 5,600 | 0.701046 | 0.316376 |
| 5,800 | 0.720158 | 0.292301 |
| 6,000 | 0.737818 | 0.270121 |
| 6,200 | 0.754140 | $0.249723 \times 10^{-4}$ |
| 6,400 | 0.769234 | 0.230985 |
| 6,600 | 0.783199 | 0.213786 |
| 6,800 | 0.796129 | 0.198008 |
| 7,000 | 0.808109 | 0.183534 |
| 7,200 | 0.819217 | $0.170256 \times 10^{-4}$ |
| 7,400 | 0.829527 | 0.158073 |

Table: Blackbody Radiation Function (Continued)

| $\lambda T$ ($\mu m \cdot K$) | $F_{(0 \to \lambda)}$ | $I_{\lambda,b}(\lambda,T)/\sigma T^5$ ($\mu m \cdot K \cdot sr$)$^{-1}$ | $\frac{I_{\lambda,b}(\lambda,T)}{I_{\lambda,b}(\lambda_{max},T)}$ |
|---|---|---|---|
| 10,500 | 0.923710 | 0.560522 | 0.077600 |
| 11,000 | 0.931890 | 0.483321 | 0.066913 |
| 11,500 | 0.939959 | 0.418725 | 0.057970 |
| 12,000 | 0.945098 | $0.364394 \times 10^{-5}$ | 0.050448 |
| 13,000 | 0.955139 | 0.279457 | 0.038689 |
| 14,000 | 0.962898 | 0.217641 | 0.030131 |
| 15,000 | 0.969981 | $0.171866 \times 10^{-5}$ | 0.023794 |
| 16,000 | 0.973814 | 0.137429 | 0.019026 |
| 18,000 | 0.980860 | $0.908240 \times 10^{-6}$ | 0.012574 |
| 20,000 | 0.985602 | 0.623310 | 0.008629 |
| 25,000 | 0.992215 | 0.276474 | 0.003828 |
| 30,000 | 0.995340 | $0.140469 \times 10^{-6}$ | 0.001945 |
| 40,000 | 0.997967 | $0.473891 \times 10^{-7}$ | 0.000656 |
| 50,000 | 0.998953 | 0.201605 | 0.000279 |
| 75,000 | 0.999713 | $0.418597 \times 10^{-8}$ | 0.000058 |
| 100,000 | 0.999905 | 0.135752 | 0.000019 |

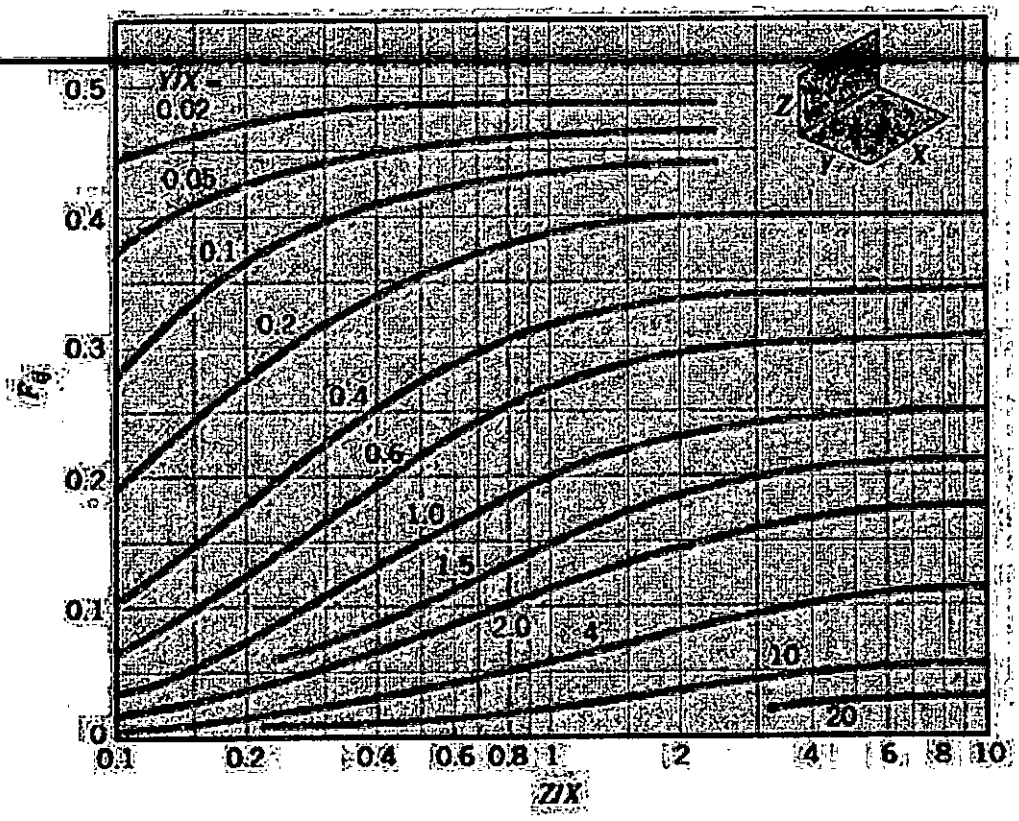



**Figure: View Factor for perpendicular rectangles with a common edge.**

L-2/T-2/MME Date: 19/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, BUET

L-2/T-2-B.Sc. Engineering Examinations 2019-2020

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

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning and interpretation.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION-A

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

1. (a) A venturi develops a low throat pressure that can aspirate fluid upward from a reservoir, as in Fig. for Q. 1(a). Using Bernoulli's equation with no losses, derive an expression for the velocity $V_1$ that is just sufficient to bring reservoir fluid into the throat in terms of $D_1$, $D_2$ and h. **(20)**

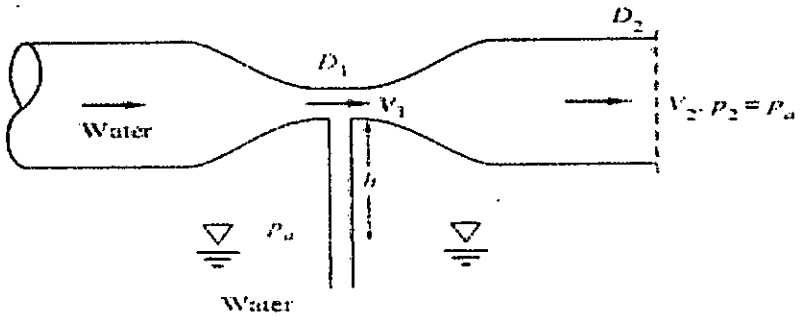



Fig. for Q. 1(a)

(b) Air at standard conditions is to be transported through **G m** of a horizontal, 300 cm×20 cm rectangular cast iron duct at a flow rate of 0.24 $m^3/s$. Calculate the pressure drop. (Assume air density=1.225 $kg/m^3$ and kinematic viscosity of air=$1.5\times10^{-5}$ $m^2/s$.) **(10)**

**G= 500+5×log(Student ID's last three Digit).**

2. (a) The system in Fig. for Q. 2(a) is open to 1 atm on the right side. If L=**C cm**, what is the air pressure in container A? (Assume air density=1.225 kg/m$^3$ and specific gravity of mercury=13.6.) **(12)**

**C= 120+5×log(Student ID's last three Digit).**

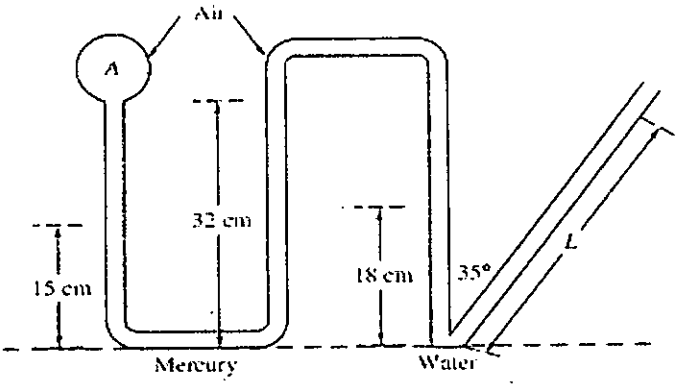
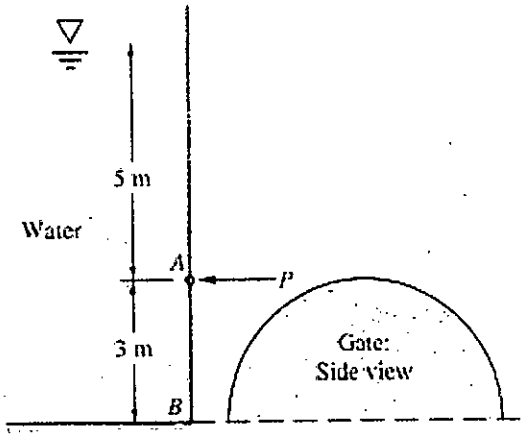
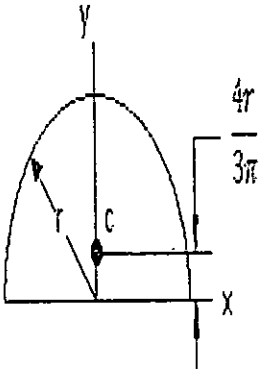



Fig. for Q. 2(a)

(b) Gate AB in Fig. for Q. 2(b) is semicircular, hinged at B, and held by a horizontal force P at A. What force P is required for equilibrium. **(18)**




$$A = \frac{\pi r^2}{2}$$

$$I_x = \frac{1}{8}\pi r^4$$

$$I_y = \frac{1}{8}\pi r^4$$

Fig. for Q. 2(b)

3. (a) An iceberg can be idealized as a cube of side length L, as in Fig. for Q. 3(a). If seawater is denoted by S=1.0, then glacier ice (which forms icebergs) has S =**D**. Determine if this "cubic" iceberg is stable for the position shown in Fig. for Q. 3(a). **(15)**

**D= 0.85+.1×log(Student ID's last three Digit).**

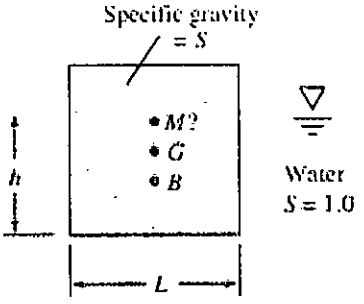



Fig. for Q. 3(a)

(b) In Fig. for Q. 3 (b) the flowing fluid is $CO_2$ at 20°C ($\rho$=1.84 kg/m$^3$). Neglect losses. If $P_1$= **F kPa** and the manometer fluid is Meriam red oil (S= 0.827), estimate $P_2$ and the gas flow rate in m$^3$/h. **(15)**

**F= 170+2×log(Student ID's last three Digit).**

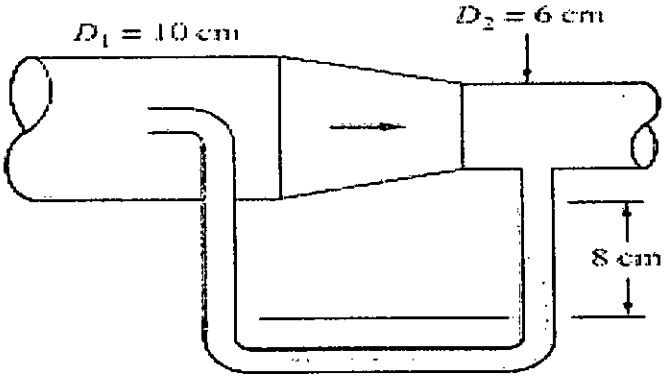



Fig. for Q. 3(b)

4. (a) A 60-cm-wide belt moves at **E m/s**, as shown in Fig. for Q. 4(a). There is an oil film of thickness 2 mm in between the belt and the solid surface. Determine the power required to drive the belt if the oil is SAE-20 ($\mu$= 0.21 Pa.s). **(10)**

**E= 10+log(Student ID's last three Digit).**

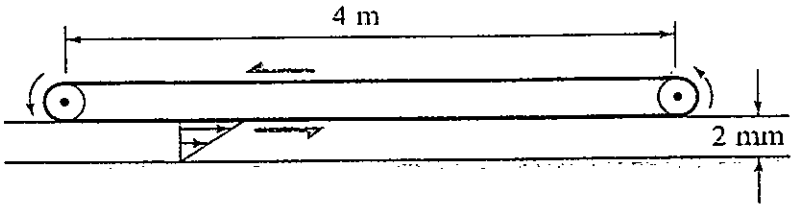



Fig. for Q. 4(a)

(b) Water is flowing from the lower reservoir into the upper reservoir at the rate of **H *l/s*** through wrought iron pipe shown in Fig. for Q. 4(b). Two elbows of loss coefficient 0.5 are present there. Entrance and exit loss coefficients are 0.45 and 0.95 respectively. The efficiency of the pump is 80%. Calculate the pump power requirement. The kinematic viscosity of water is 1.02 x $10^{-6}$ $m^2/s$. **(20)**

**H=30+3×log(Student ID's last three Digit).**

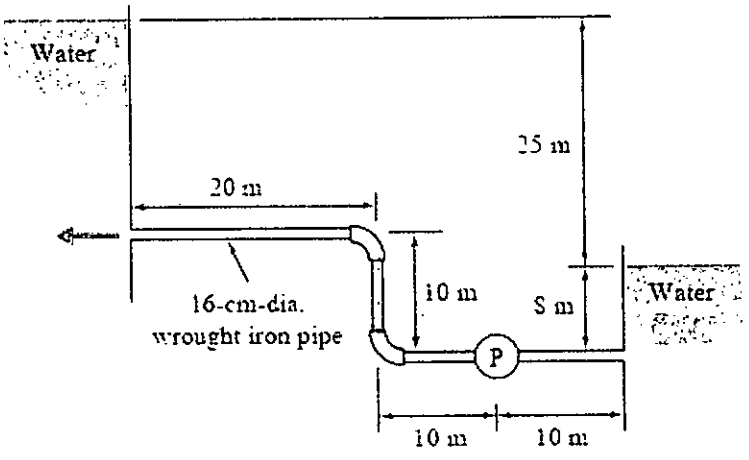



Fig. for Q. 4(b)

## SECTION-B

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

**ASSUME REASONABLE VALUES IF DATA ARE MISSING**

5. (a) Using Chezy-Manning equation, find the bed slope of a trapezoidal open channel of bed width W , depth of water 3 m and side slope of 45 deg with the horizontal, when the discharge through the channel is 20 $m^3/s$. Take N = 0.3. W (m) = (Last two digits of your student ID + 35)/20 **(15)**

   (b) Find the condition for a rectangular open channel to have the most economical cross section. **(15)**

6. (a) A jet of fluid is striking at velocity V along the centre of a symmetrical curved vane moving at velocity u. Find an expression for the maximum efficiency of the system. What will be value of the maximum efficiency if the vane is semicircular? **(20)**

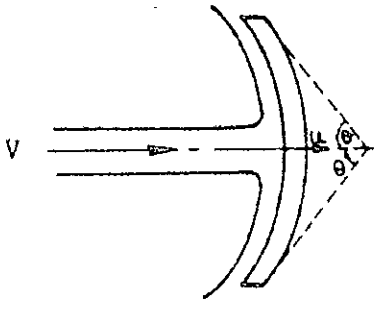



Fig. for Q-6(a)

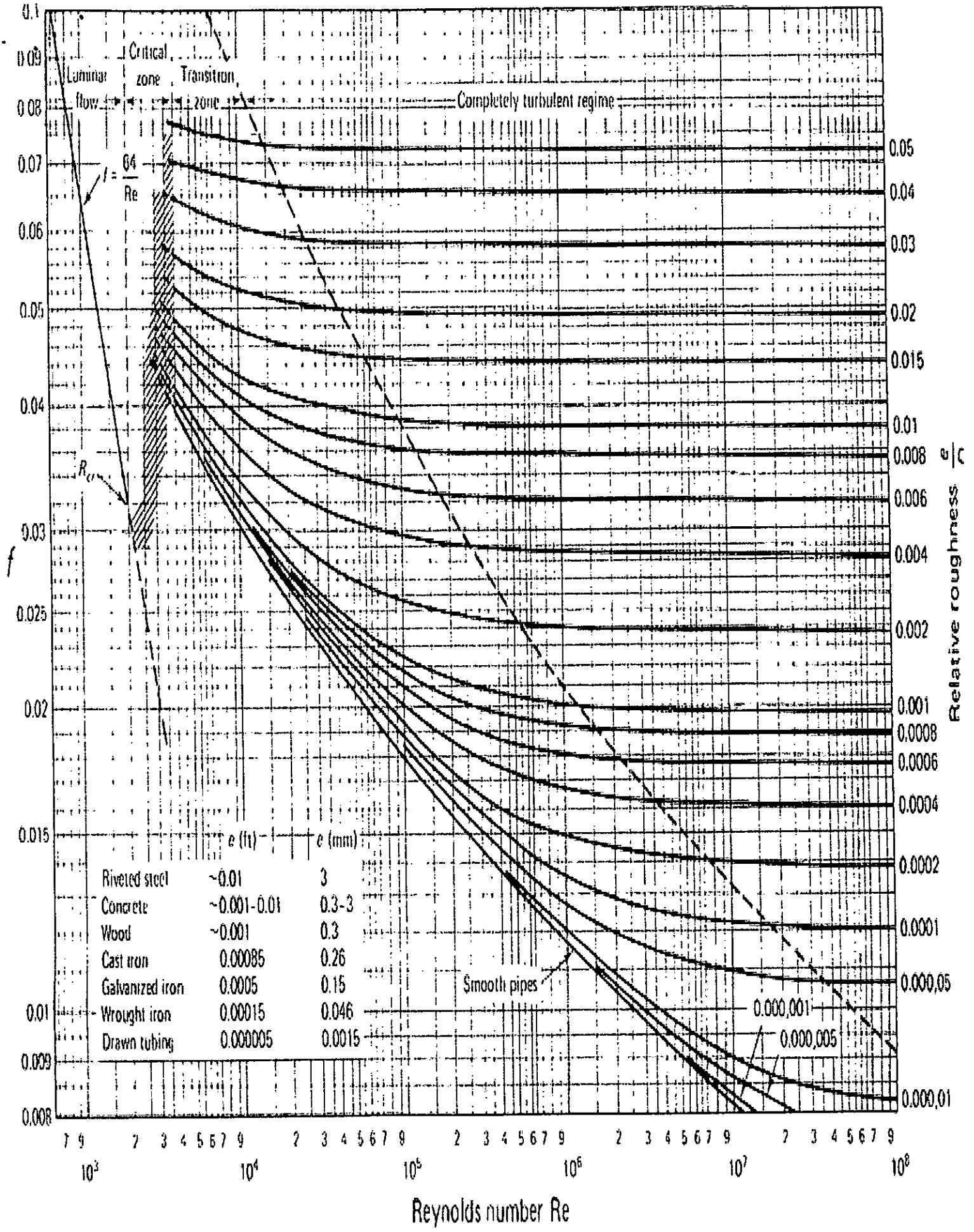
   (b) Draw a simple neat sketch of a centrifugal pump impeller to show the path of fluid flow through it. **(10)**

7. (a) Define Euler head and manometric head. Derive the condition for minimum starting speed of a centrifugal pump in terms of manometric head. **(18)**

   (b) Draw the typical characteristic curves of a centrifugal pump and show the following: duty point, best efficiency point, shut-off head, shut-off power. **(12)**

8. (a) What is NPSH? Explain why it is necessary to keep the NPSH always positive. **(10)**

(b) A three throw reciprocating pump is delivering 0.1 $m^3/s$ of water against a head of H in m. Diameter and stroke length of the cylinder are 250 mm and 500 mm, respectively. Friction losses amount to 1 m in the suction pipe and 20 m in the delivery pipe. If the velocity of water in the delivery pipe is 1.4 m/s, pump efficiency 90% and slip 2%, determine the pump speed and input power. Take H (m) = Last two digits of your student ID + 75 **(20)**


Laminar flow
Critical zone
Transition zone
Completely turbulent regime
$f = \frac{64}{Re}$
$R_{cr}$
f
Reynolds number Re
Relative roughness e/d
e (ft)
e (mm)
Riveted steel ~0.01 3
Concrete ~0.001-0.01 0.3-3
Wood ~0.001 0.3
Cast iron 0.00085 0.26
Galvanized iron 0.0005 0.15
Wrought iron 0.00015 0.046
Drawn tubing 0.000005 0.0015
Smooth pipes
0.05
0.04
0.03
0.02
0.015
0.01
0.008
0.006
0.004
0.002
0.001
0.0008
0.0006
0.0004
0.0002
0.0001
0.000,05
0.000,01
0.000,001
0.000,005

L-2/T-2/MME Date: 09/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-II B.Sc. Engineering Examination 2018-19

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

Full Marks: 180 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 6 page(s) in this question paper.

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## SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**
All the symbols have their usual meanings
Assume reasonable values for missing data.

1. (a) The unbalanced load of Fig. 1(a) is supplied by balanced line-to-line voltages of 240 V in. Take $V_{ab}$ as reference and assume acb sequence. Calculate the line currents $I_{aA}$, $I_{bB}$, $I_{cC}$. All impedances are given in Ω. (15)

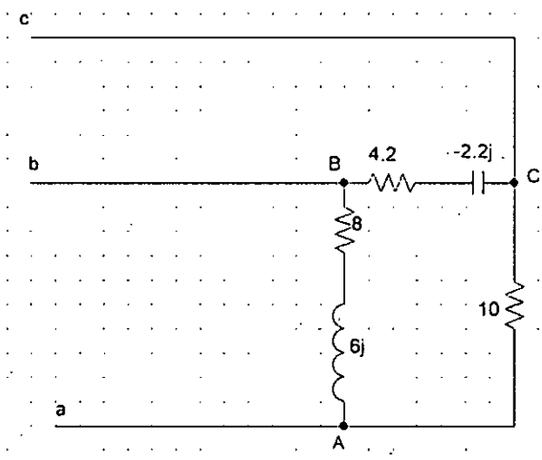


Fig. 1(a)

(b) Two balanced loads are connected to a 13.8 kV rms 60-Hz line, as shown in Fig. 1(b). Assume abc sequence. Calculate the line currents, total real power, total reactive power and the combined power factor. Comment on the combined power factor. (15)

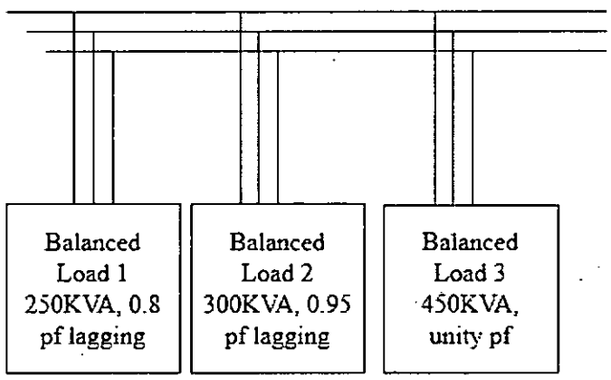


Fig. 1(b)

2. (a) A 1000-VA 230/115-V transformer has the following test data: (15)

| Open circuit test | Short circuit test |
|---|---|
| $V_{OC}$=230V | $V_{SC}$=19.1V |
| $I_{OC}$=0.45V | $I_{SC}$=8.7A |
| $P_{OC}$=30W | $P_{SC}$=42.3W |

All data given were taken from the primary side of the transformer.

(i) Calculate the equivalent circuit parameters of this transformer referred to the low-voltage side of the transformer. Draw the equivalent circuit with numerical values.

(ii) Calculate the transformer's voltage regulation at rated conditions and 0.8 PF lagging.

(iii) Determine the transformer's efficiency at rated conditions and 0.8 PF lagging.

(b) A 15hp, 240V 1200 r/min DC shunt motor with compensating windings has (15) $R_A$=0.4 Ω, $R_{adj}+R_F$=250 Ω, $I_{L,rated}$=55A which produces a no load speed of 1200 r/min. Draw the equivalent circuit of this motor. Find the motor speed and speed regulation at rated condition.

3. (a) Three identical 3MW 0.8 PF lagging synchronous generator has the (15) following $S_{PA}$

| Generator A | Generator B | Generator C |
|---|---|---|
| 1.5 MW/Hz. | 1.676 MW/Hz. | 1.961 MW/Hz. |

(i) Suppose the generator A is to be connected to a 11KV 60Hz infinite bus. What would happen if the governor set point is (1) 59Hz and (2) 61Hz? Show necessary calculations and house diagram. Based on your answer state one condition for parallel operation.

(ii) Suppose the three generators are to be connected in parallel to supply a combined load of 7MW at 59.61Hz. The governor set point of three generators are set as

| Generator A | Generator B | Generator C |
|---|---|---|
| 61Hz. | 61.5Hz. | 60.5 Hz. |

Calculate the real power sharing among the generators. Comment on the power sharing in this case. What actions could an operator take to improve the real power sharing among these generators?

(b) A 208V, 45kVA, 0.8PF leading, Δ-connected 4pole, 60-Hz synchronous motor has a synchronous reactance of 2.5 Ω and a negligible armature resistance. (15)

(i) Draw the torque-speed characteristics with numeric values.

(ii) If the motor has input power of 13.7KW at 0.8 pf leading, find the internally generated voltage. What would happen if the input power is increased to 25KW? Find the internally generated voltage and power factor after load change. Show both cases in a single phasor diagram.

4 (a) A 208V, 60Hz 6pole, Y-connected, 18.6KW design class A induction motor has the following test results: (30)

No Load: 208V, 22A, 1200W, 60Hz

Locked rotor: 24.6V, 64.5A, 2200W, 15Hz

DC test: 13.5V, 64A

(i) Sketch the per-phase equivalent circuit of this motor with numeric values.

(ii) If the slip is 2%, find the stator current at rated condition.

(iii) Draw the power flow diagram with numeric values. Assume core loss is 200W and rotational loss is 800W

(iv) Calculate the efficiency of this motor.

## SECTION – B

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

All the symbols have their usual meanings

Assume reasonable values for missing data.

5. (a) For the circuit in the fig 5(a) below, sketch separate graphs of $V_{da}$, $V_{ac}$, and $V_{ab}$ with respect to time for $0 \leq t \leq 2T$. Specify important points on both axes. Assume that the diodes are ideal. (15)

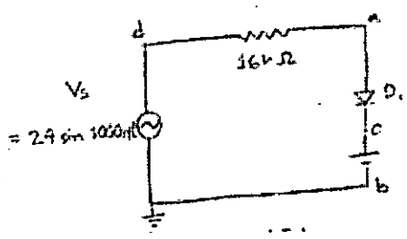


Fig 5(a)

(b) (i) For the circuit in the fig 5(b), sketch $V_{out}$ for $0 \leq t \leq 2T$. Specify important points on both axes. (15)

(ii) Find I and V.

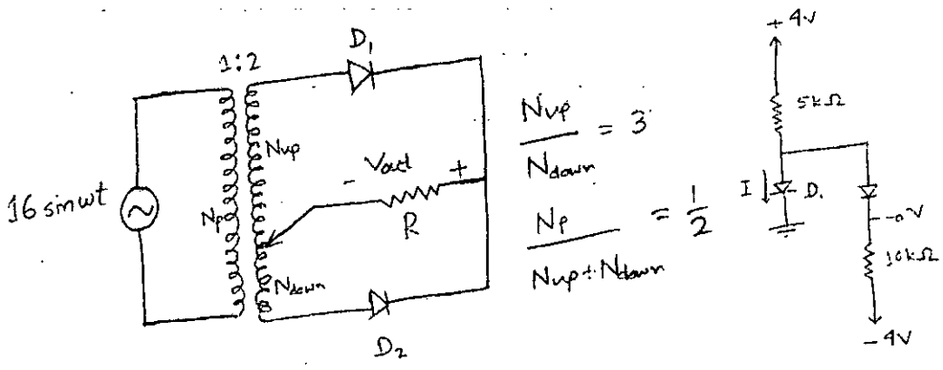


Fig 5(b)

6. (a) An npn transistor with a common current gain factor of 99 is operating in active mode. The Q-point is set at (3.5 mA, 5V) using a biasing circuit as shown in the Fig 6(a). Due to a fluctuation in the biasing voltage $V_{CC}$, the base current is found to be increased by 15%. Determine the required percentage adjustment of the biasing voltage to keep the Q-point fixed. (20)

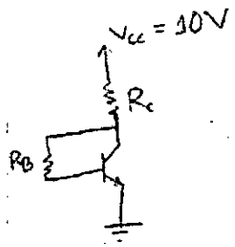


Fig 6(a)

(b) Derive the expression for the small signal output voltage of a common-source BJT amplifier. (10)

7. (a) Write the expression of $V_{out}$ in terms of $V_{in}$, $R_{in}$, and C. Sketch a qualitative graph of $V_{out}$ for the input voltage as shown in the graph in fig 7(a). (15)

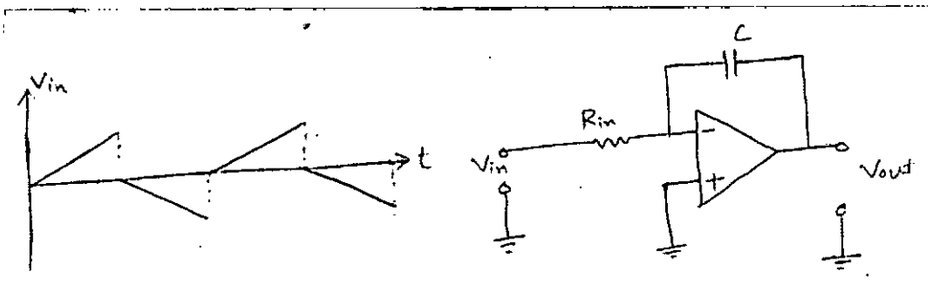


Fig 7(a)

(b) From fig 7(b) find $v_0$. (15)

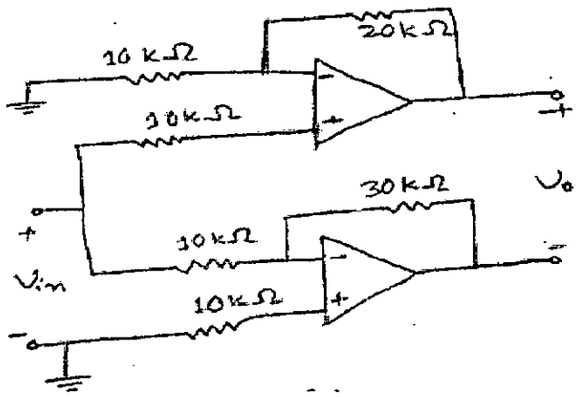


Fig 7(b)

8. (a) Calculate the drain current and source-to-drain voltage of a common source circuit with a p-channel enhancement-mode MOSFET. (20)

Consider the circuit shown in fig 8 (a). Assume that $R_1 = R_2 = 50\ k\Omega$, $V_{DD} = 5\ V$, $R_D = 7.5\ K\Omega$, $V_{TP} = -0.8\ V$, *and* $K_p = 0.2\ mA/V^2$

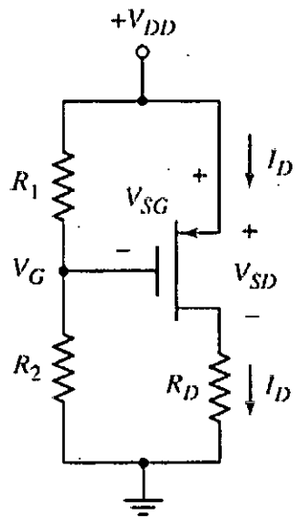


Fig 8(a)

(b) For a 0.8-$\mu$m process technology for which $t_{ox} = 15$ nm and $\mu_n = 550\ cm^2/V \cdot s$, find $C_{ox}$, $K_n'$ and the overdrive voltage $V_{ov}$ required to operate a transistor having $W/L = 20$ in saturation with $I_D = 0.2mA$. What is the minimum value of $V_{DS}$ needed? (10)

L-2/T-2/MME Date: 12/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B.Sc. Engineering Examination, January 2020

Sub: **HUM 103** (Economics)

Full Marks: 180 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 03 page(s) in this question paper.

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## SECTION – A

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

All the symbols have their usual meanings

Assume reasonable values for missing data.

1. A firm producing two goods "A" and "B" has the profit function

$Z = 320A - 10A^2 + 20AB - 20B^2 + 160B - 70$

(a) What are the profit-maximizing level of output for each of the two goods? (20)

(b) Test whether profits are maximized. What is the maximized amount of profit? (10)

2. (a) ) Either coal (C) or gas (G) can be used in the production of steel. The cost of coal is 200, the cost of gas 1000. Draw an isocost curve showing the different combinations of gas and coal that can be purchased (i) with an initial expenditure (E) of 20,000, (ii) if expenditures increase by 50 percent, (iii) if the price of gas is reduced by 20 percent, (iv) if the price of coal rises by 25 percent. Always start from the original equation. (10)

(b) What are the assumptions of a monopolistically competitive market? Explain. (10)

(c) What are the shut down and break-even conditions of a firm under perfect competition? Show graphically and explain. (10)

3. (a) Using the information given in Table 1 calculate Gross Domestic Product (GDP) in Expenditure method and Income method. (20)

**Table 1: Expenditures and Income**

| | |
|---|---|
| Transfer Payments | $54 |
| Interest Income | $150 |
| Depreciation | $36 |
| Wages | $69 |
| Gross Private Investment (I) | $124 |
| Business Profits | $200 |
| Indirect Business Taxes | $74 |
| Rental Income | $75 |
| Net Exports (X-M) | $20 |
| Net Foreign Factor Income | $12 |
| Government Purchases (G) | $156 |
| Household Consumption (C) | $304 |

(b) Calculate GDP in value addition approach considering any arbitrary good/service. (10)

4 (a) Why is an understanding of development crucial to policy formulation in developing nations? (10)

(b) Why is a strictly economic definition of development inadequate? What do you understand development to mean? Can you give hypothetical or real examples of situations in which a country may be developing economically but may still be underdeveloped? (20)

## SECTION – B

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

All the symbols have their usual meanings

5. (a) Define demand function. From the following demand function, make a hypothetical demand schedule and plot the curve. (15)

$$Q = 200 - 20P + P^2.$$

(b) What are the main causes of shifting of the demand curve? Explain them. (15)

6. (a) How would you measure price elasticity of demand at any point of a straight line demand curve? Explain graphically. (15)

(b)Define cross elasticity of demand. From the following table calculate elasticity of demand if you move from point A to C and explain what you understand from the result. (15)

| POINT | Y | Q |
|---|---|---|
| A | 1500 | 50 |
| B | 1600 | 60 |
| C | 1700 | 70 |

7. (a) Define budget line. Explain consumer's equilibrium with the help of budget line and indifference curve. (15)

(b) From the following budget line and the utility function, calculate the amount of two commodities that maximizes satisfaction. What is the maximum amount of satisfaction? (15)

$$5000 = 40X + 50Y$$

$$U = 1500\ X^{0.6}Y^{0.7}$$

8. (a) What do you understand by internal economies of scale and external economies of scale? (10)

(b) Explain different types of internal economies of scale. (20)

L-2/T-2/ MME Date: 12/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B.Sc. Engineering Examination- January 2020

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

Full Marks: 180 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 7 page(s) in this question paper.

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## SECTION – A

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

1. Marry Jone has the following transactions for the month of May 2019 for her business. **(30)**

May-1: The owner Investment tk. 10,00,000 cash.

May-2: Advertise on account tk. 5,000.

May-5: Purchase supplies for cash tk. 6,000.

May-10: Purchase office equipment for tk. 2,50,000, paying tk. 50,000 in cash and remaining on account.

May-12: Service provided on account tk. 3,00,000.

May-15: Withdraw cash for personal use tk.10,000.

May-18: Salary for the month paid in cash tk.25,000.

May-20: Paid balance due for advertisement.

May-22: Cash received from customer for May 12 transaction.

May-24: Provide services for cash tk. 20,000.

Required: (i) Prepare necessary journal entries for May 2019.

(ii) Prepare a cash ledger account.

2. (a) Following are the account balances of Harry Computer Service Limited Company for the Year on 31st August 2019. (20)

| Account Title | Amount (tk.) | Account Title | Amount (tk.) |
|---|---|---|---|
| Cost of Computer | 20,00,000 | Bad Debts | 50,000 |
| Sale of Computer | 34,00,000 | Prepaid Insurance | 50,000 |
| Service fees received | 3,00,000 | Office equipment | 60,000 |
| Salaries to engineers | 2,00,000 | Salary to Staff | 85,000 |
| Advertisement expense | 50,000 | Bank Balance | 4,55,000 |
| Office Rent | 60,000 | Unpaid Salaries | 5,000 |
| Maintenance expense | 1,30,000 | Accounts Receivable | 6,00,000 |
| Account Payable | 80,000 | Beginning Inventories | 4,00,000 |
| Tax payable | 5,000 | Furniture | 2,50,000 |
| Capital | 6,00,000 | | |

**Required:** Prepare a trial balance on 31st August 2019.

(b) Selected comparative data for Jacob Incorporation are presented below: (10)

| Particulars | 2019 (tk.) | 2018 (tk.) |
|---|---|---|
| Net Sales (all in credit) | 7,50,000 | 7,20,000 |
| Cost of Goods Sold | 4,80,000 | 4,40,000 |
| Interest Expense | 7,000 | 5,000 |
| Net Income | 45,000 | 42,000 |
| Account Receivable | 1,20,000 | 1,00,000 |
| Inventory | 85,000 | 75,000 |
| Total Assets | 5,80,000 | 5,00,000 |
| Total Shareholders' Equity | 4,30,000 | 3,25,000 |

Required: Compute the following ratios for 2019.

i. Profit Margin

ii. Asset Turnover

iii. Return on Shareholders' Equity

iv. Inventory Turnover

v. Accounts Receivable Turnover

3. The trial balance of Millar Company on September 30, 2019 is given below: **(30)**

| Millar Company<br>Trial Balance<br>September 30, 2019 | | |
|---|---|---|
| Account Title | Debit (tk.) | Credit (tk.) |
| Cash | 12,800 | |
| Supplies | 2,500 | |
| Prepaid Insurance | 3,000 | |
| Office Equipment | 5,000 | |
| Note Payable | | 5,000 |
| Account Payable | | 2,500 |
| Unearned Revenue | | 1,200 |
| Capital | | 10,000 |
| Drawings | 500 | |
| Service Revenue | | 10,000 |
| Salary Expense | 4,000 | |
| Utility Expense | 900 | |
| Total | 28,700 | 28,700 |

Analysis reveals the following additional data:

- Supplies on hand on September 30, tk. 1,200.
- Insurance policy is for two years.
- Depreciation tk. 200 for each month.
- Unearned revenue is still unearned tk. 800.
- Service provided but not received tk. 1,200.

Required: (i) Prepare adjusting entries for September 30, 2019.

(ii) Prepare adjusted trial balance as on September 30, 2019.

4. The following is the trial balance of Gordon Company as on December 31st, 2019. **(30)**

| Gordon Company<br>Trial Balance<br>December 31st 2019 | | |
|---|---|---|
| Account Title | Debit (tk.) | Credit (tk.) |
| Sales Revenue | | 50,000 |
| Merchandise Inventory (01.01.19) | 6,000 | |
| Purchase | 24,000 | |
| Purchase Return | | 1,000 |
| Sales discounts | 2,500 | |
| Accounts Receivable | 20,000 | |
| Accounts Payable | | 14,000 |
| Capital | | 40,000 |
| Drawings | 10,000 | |
| Salaries | 8,000 | |
| Supplies | 3,000 | |
| Delivery Van | 20,000 | |
| Cash | 9,300 | |
| Prepaid Insurance | 2,200 | |
| Total | 1,05,000 | 1,05,000 |

Other Information:

- Supplies used tk. 1,200.
- Depreciation on delivery van is tk. 2,000.
- Merchandise Inventory (31.12.19) was tk. 5,500.
- Tk. 2,500 of accounts receivable was uncollectible.
- Salaries were accrued tk. 4,000.
- Insurance expense was tk. 2,000.

Required: (a) Prepare a classified Income Statement and Owners Equity Statement.

(b) Prepare a classified Balance Sheet as on 31st December 2019.

## SECTION – B

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

5. (a) The number of X -rays taken and X-ray costs over the last six months in Beverly Hospital are given below: (20)

| Month | X-Rays Taken | X-Ray Costs (Tk.) |
|---|---|---|
| January | 6,250 | 28,000 |
| February | 7,000 | 29,000 |
| March | 5,000 | 23,000 |
| April | 4,250 | 20,000 |
| May | 4,500 | 22,000 |
| June | 3,000 | 17,000 |

Required:

(i) Using high and low point method, determine the variable and fixed cost elements for conducting X-ray.

(ii) Express the variable and fixed costs in the form Y=a +b X

(iii) Using the cost formula, you derived above, what X-Ray costs would you expect to be incurred during a month in which 4,600 X-rays are taken?

(b) Listed below are a few costs typically found in an organization: (10)

(i) Burger buns in Express Foods.

(ii) Apples processed and canned by Red Apple.

(iii) Thread used in garments factory.

(iv) Wages of workers assembling furniture.

(v) Advertising by a consulting office.

(vi) Sugar used in soft drinks production.

(vii) Depreciation of factory equipment.

(viii) Factory supervisor's salary.

(ix) Shipping cost in manufacturing company.

(x) Property taxes on the factory.

Required:

Classify each cost as either variable, fixed or mixed cost with respect to the volume or level of activity.

6. Consider the following data relating to Stratford Manufacturing Company for the period ended on December 31, 2019: (30)

Cost data:

Variable manufacturing cost:

| | |
|---|---|
| Direct materials | Tk. 25 |
| Direct labour | Tk. 12 |
| Variable manufacturing overhead | Tk. 13 |
| Variable selling and administrative overhead | Tk. 10 |

Fixed Cost:

| | |
|---|---|
| Fixed manufacturing overhead | Tk. 250,000 |
| Fixed selling and administrative overhead | Tk. 150,000 |

Production and Sales Data:

| | |
|---|---|
| Units produced | 25,000 units |
| Units sold | 20,000 units |
| Unit selling price | Tk. 100 |

Required:

(i) Compute unit product cost under absorption costing and variable costing.

(ii) Prepare income statements under absorption costing and variable costing.

7. A company is going to purchase a new machine. The related information of machine is given below:

Cost of the machine: Tk. 80,000 (30)

| Year | Net Profit After Tax |
|---|---|
| 1 | Tk. 35,000 |
| 2 | 12,000 |
| 3 | 18,000 |
| 4 | 10,000 |
| 5 | 8,000 |

Required:

(i) Pay Back Period

(ii) Internal Rate of Return (IRR)

(iii) Net Present Value (NPV) at 10% cost of capital

(iv) Profitability Index

8. Starline Co. produces a single product. The company's income statement for the most recent month is given below: **(30)**

| | |
|---|---|
| Sales (13,500 units @ Tk. 20) | Tk. 2,70,000 |
| Less: variable expenses | 1,89,000 |
| Contribution margin | 81,000 |
| Less: fixed expenses | 90,000 |
| Net loss: | Tk. (9,000) |

Requirement:

(i) Compute the company's CM Ratio.

(ii) Compute break-even point (BEP) in both units and taka.

(iii) The sales manager feels that an Tk. 8000 increase in the monthly advertising budget, combined with an intensified effort by the sales staff, will results in a Tk. 70,000 increase in monthly sales. If the sales manager is right what will be the effect on the company's monthly net income or loss?

(iv) Refer to the original data. The company's advertising agency thinks that a new package for the company's product would help sales. The new package being proposed would increase packaging costs by Tk. 0.60 per unit. Assuming that no other changes in cost behavior, how many units would have to be sold each month to earn a profit of Tk. 4,500?

(v) Compute the company's margin of safety.