L-2/T-1/ME **Date : 07/12/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **ME 241** (Engineering Mechanics)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Collars A and B are connected by a 525-mm long wire and can slide freely on frictionless rods as shown in Figure for Q. 1(a). If a force P = (341 N)j is applied to collar A, determine the tension in the wire when y = 155 mm. **(20)**

   (b) The wire AE is stretched between the corners A and E of a bent plate as shown in Figure for Q. 1(b). Knowing that the tension in the wire is 435 N, determine the moment about O of the force exerted by the wire on corner E. Using this moment determine the perpendicular distance from point O to wire AE. **(26⅔)**

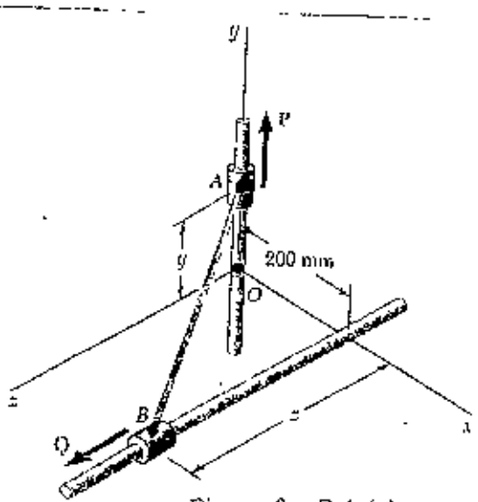

Figure for Q.1 (a)

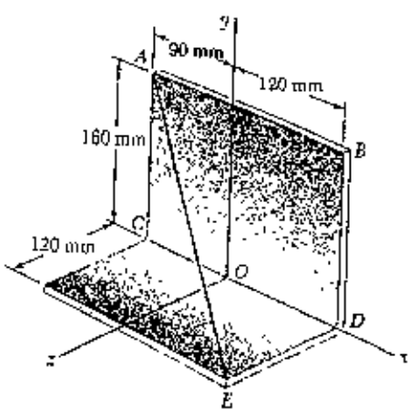

Figure for Q.1 (b)

2. (a) For the frame and loading as shown in Figure for Q. 2(a), determine the reactions at C and D. **(23)**

   (b) A Fink roof truss is loaded as shown in Figure for Q. 2(b). Determine the force in members BD, CD and CE. **(23⅔)**

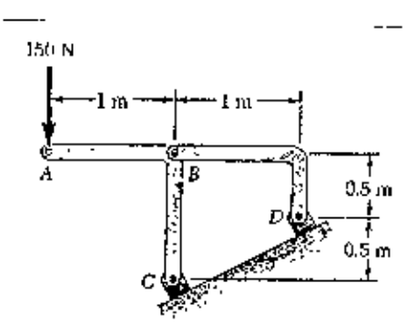

Figure for Q.2 (a)

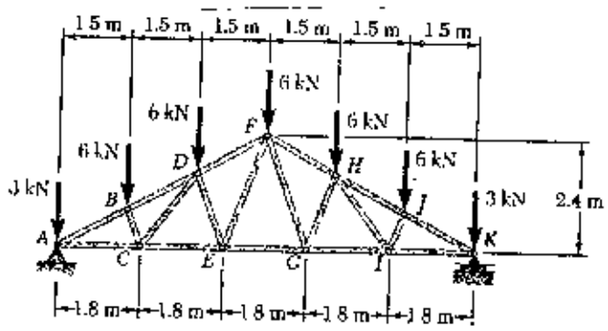

Figure for Q.2 (b)

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Contd P/2

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3. (a) Determine the y co-ordinate of the centroid of the body shown in Figure for Q. 3(a). **(23)**

(b) For the frame and loading as shown in Figure for Q. 3(b), determine the components of all forces acting on member ABC. **(23⅓)**

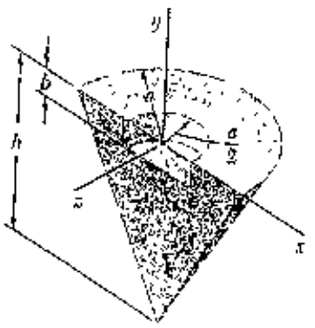

Figure for Q.3 (a)

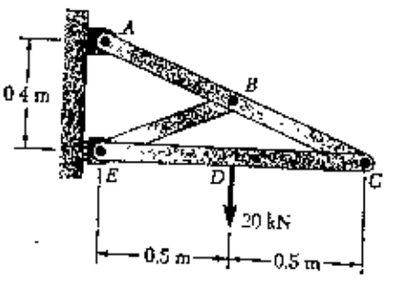

Figure for Q.3 (b)

4. (a) Block A supports a pipe column and rests on wedge B as shown in Figure for Q. 4(a). Knowing that the co-efficient of static friction at all surfaces of contact is 0.25 and that $\theta = 45^\circ$, determine the smallest force P for which equilibrium is maintained. **(23)**

(b) Determine by direct integration the mass moment of inertia with respect to the y axis of the paraboloid as shown in Figure for Q. 4(b), assuming that it has a uniform density and a mass m. **(23⅓)**

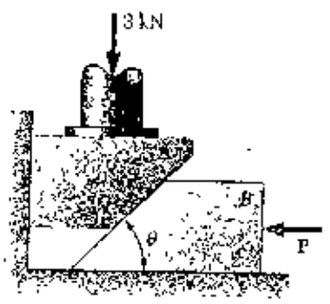

Figure for Q 4 (a)

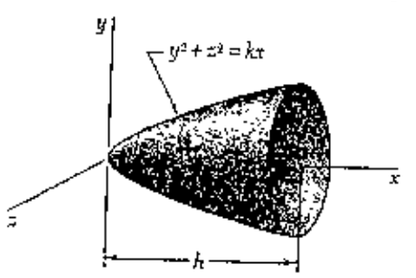

Figure for Q.4 (b)

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SECTION – B

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

Assume any missing data.

5. (a) Slider block A moves to the left with a constant velocity of 6 m/s as shown in Figure for Q. No. 5(a). Determine (i) the velocity of block B, (ii) the velocity of portion D of the cable, (iii) the relative velocity of portion C of the cable with respect to portion D. **(20)**

(b) The velocity of block A is 2 m/s to the right at the instant (Figure for Q. 5(b)) when $r = 0.8$ m and $\theta = 30°$. Neglecting the mass of the pulley and the effect of friction in the pulley, and between block A and the horizontal surface, determine at this instant, (i) the tension in the cable, (ii) the acceleration of block A, (iii) the acceleration of block B. **(26⅔)**

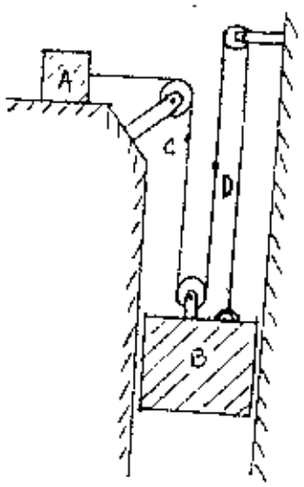

Figure for Q. No. 5(a)

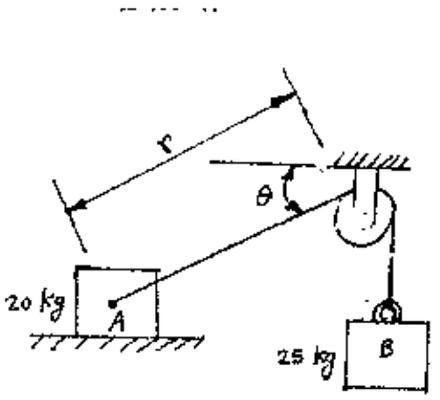

Figure for Q. No. 5(b)

6. (a) A 500 g collar is attached to a spring and slides without friction along a circular rod in a vertical plane as shown in Figure for Q. No. 6(a). The spring has a undeformed length of 125 mm and a constant k = 150 N/m. Knowing that the collar is released from being held at A, determine the speed of the collar and the normal force between the collar and the rod as the collar passes through B. **(20)**

(b) Three identical small spheres, each of mass 1 kg, can slide freely on a horizontal frictionless surface as shown in Figure for Q. No. 6(b). Spheres B and C are connected by a light rod and are at rest in the position shown when sphere B is struck by sphere A which is moving to the right with a velocity $V_0 = (2.4 \text{ m/s})\,\mathbf{i}$. Knowing that $\theta = 45°$, and that the velocities of spheres A and B immediately after the impact are $V_A = 0$ and $V_B = (1.8 \text{ m/s})\,\mathbf{i} + (V_B)_y\,\mathbf{j}$, determine $(v_B)_y$ and the velocity of C immediately after impact. **(26⅔)**

Contd P/4

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Contd... Q. No. 6

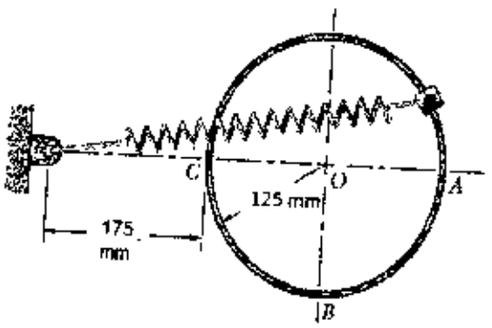


Figure for Q. No. 6(a)

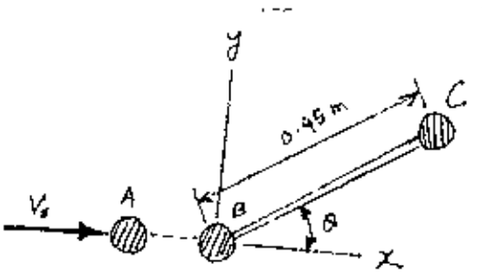


Figure for Q. No. 6(b)

7. (a) The nozzle discharges water at the rate of 1.3 m^3/min, as shown in the Figure for Q. No. 7(a). Knowing the velocity of the water at both A and B has a magnitude of 20 m/s and neglecting the weight of the vane, determine the components of reactions at C and D. **(26⅔)**

(b) Collar A moves upward with a constant velocity of 1.2 m/s as shown in Figure for Q. No. 7(b). At the instant shown, when θ = 25°, determine (i) the angular velocity of rod AB, (ii) the velocity of collar B. **(20)**

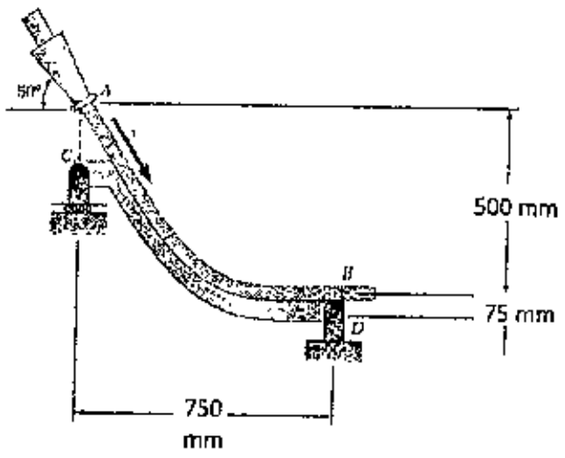


Figure for Q. No. 7(a)

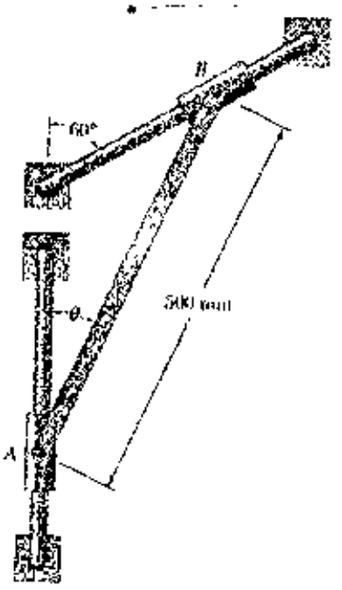


Figure for Q. No. 7(b)

Contd P/5

ME 241/ME

8. (a) The collar P slides outward at a constant relative speed u along rod AB, which rotates counterclockwise with a constant angular velocity of 20 rpm, as shown in Figure for Q. No. 8(a). Knowing that r = 250 mm when θ = 90°, determine the magnitude of the acceleration of the collar P just as it reaches B. **(23)**

(b) The 4 kg uniform rod ABD is attached to the crank BC and is fitted with a small wheel that can roll without friction along a vertical slot, as shown in Figure for Q. No. 8(b). Knowing that at the instant shown crank BC rotates with an angular velocity of 6 rad/s clockwise and an angular acceleration of 15 rad/s^2, counterclockwise, determine the reaction at A. **(23⅓)**

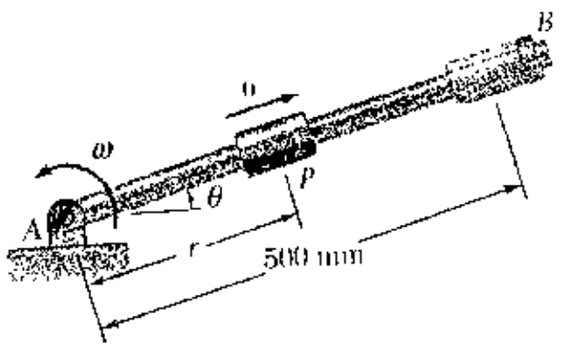


Figure for Q. No. 8(a)

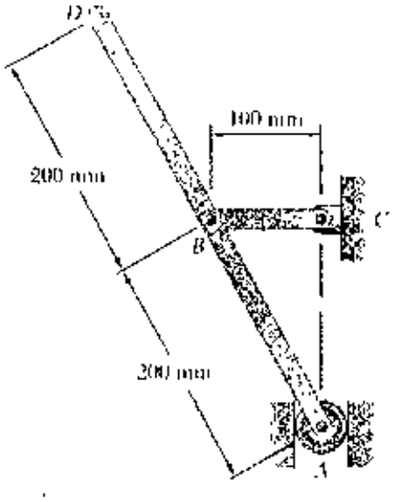


Figure for Q. No. 8(b)

L-2/T-1/ME **Date : 13/12/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **MATH 261** (Vector Calculus, Matrices, Laplace Transform and Series Solution)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Symbols have their usual meaning.

1. (a) Define elementary matrix. Find a sequence of elementary matrices that can be used to write the matrix A in row-echelon form where **(15⅔)**

$$A=\begin{bmatrix} 0 & 1 & 3 & 5 \\ 1 & -3 & 0 & 2 \\ 2 & -6 & 2 & 0 \end{bmatrix}$$

(b) Assume that $\underline{u}=(2,-2,0), \underline{v}=(6,1,4), \underline{w}=(2,0,-4)$ are vectors in $\Re^3$ having their initial points at the origin. Determine whether the three vectors lie in a plane. **(15)**

(c) For the matrix $A=\begin{bmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \\ 0 & -1 & -1 \end{bmatrix}$, find non-singular matrices P and Q such that PAQ is in the normal form. **(16)**

2. (a) If $\lambda_1, \lambda_2, \cdots, \lambda_n$ are the eigenvalues of A, then prove that **(12)**

   (i) $k\lambda_1, k\lambda_2, \ldots, k\lambda_n$ are the eigenvalues of the matrix kA, where k is a non - zero scalar.

   (ii) $\frac{1}{\lambda_1}, \frac{1}{\lambda_2}, \cdots, \frac{1}{\lambda_n}$ are the eigenvalues of the inverse matrix A^{-1}.

   (iii) $\lambda_1^p, \lambda_2^p, \cdots, \lambda_n^p$ are the eigenvalues of A^p, where p is any positive integer.

(b) If $A=\begin{pmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{pmatrix}$, find the eigenvalues of $(A-3I)^2$. **(10⅔)**

(c) For the real symmetric matrix A, find a non-singular matrix P such that P^TAP is diagonal and also find its rank, index and signature where **(24)**

$$A=\begin{pmatrix} 1 & -3 & 2 \\ -3 & 7 & -5 \\ 2 & -5 & 8 \end{pmatrix}$$

Contd P/2

MATH 261/ME

3. (a) A particle moves along the curve $\underline{r}(t)=(t^3-4t)\underline{i}+(t^2+4t)\underline{j}+(8t^2-3t^3)\underline{k}$, where t is the time. Find the magnitudes of the tangential and normal components of its acceleration when $t = 2$. **(17⅓)**

(b) Find equations for the tangent plane and normal line to the surface $z=x^2+y^2$ at the point (2, -1, 5). **(12)**

(c) Show that $\underline{E}=\underline{r}/r^2$ is irrotational. Find ϕ such that $\underline{E}=-\nabla\phi$ and $\phi(a)=0$, where $a>0$. **(17)**

4. (a) Show that $\int_C (y^2-6xy+6)dx+(2xy-3x^2)dy$ is independent of path between (-1, 0) and (3, 4). **(10⅔)**

(b) If $\underline{F}=2y\underline{i}-z\underline{j}+x^2\underline{k}$ and S is the surface of the parabolic cylinder $y^2=8x$ in the first octant bounded by the planes y =4 and z = 6, evalnate $\iint_S \underline{F}.\underline{n}dS$. **(16)**

(c) Verify Stokes' Theorem for $\underline{F}=(y-z+2, yz+4, -xz)$ where S is the surface of the cube x = 0, y = 0, z = 0, x = 2, y = 2, z = 2 above xy-plane. **(20)**

SECTION – B

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

5. (a) Find the series solntion of the differential equation $(x-x^2)y''+(1-x)y'-y=0$ by the method of Fröbenius. **(36⅔)**

(b) Show that $P_n(-x)=(-1)^n P_n(x)$ and hence deduce that $P_n(-1)=(-1)^n$. **(10)**

6. (a) Show that the Legendre polynomial $P_n(x)$ is the coefficient of h^n in the expansion of $(1-2xh+h^2)^{-1/2}$. **(30⅔)**

(b) Prove that $\int_{-1}^{1} P_n(x)P_m(x)dx=\begin{cases}0 & , m\neq n\\ \dfrac{2}{2n+1} & , m=n\end{cases}$. **(16)**

Contd P/3

MATH 261/ME

7. Show that

(i) $\frac{d}{dx}[x J_n(x) J_{n+1}(x)] = x[J_n^2(x) - J_{n+1}^2(x)]$ **(15)**

(ii) $\int_0^x x^2 J_0(x) J_1(x) dx = \frac{1}{2} x^2 J_1^2(x)$. **(15)**

(b) State and prove Heariside expansion formula; using above formula find

$L^{-1}\left\{\frac{3s+1}{(s-1)(s^2+1)}\right\}$. **(16⅔)**

8. (a) If $f(t)$ be a periodic function with period $T > 0$, find $L\{f(t)\}$. **(10⅔)**

(b) Find **(8+8=16)**

(i) $L\left\{\int_0^t \frac{1-e^{-u}}{u} du\right\}$

(ii) $L^{-1}\left\{\frac{1}{(s^2+a^2)^{3/2}}\right\}$.

(c) Solve the following differential equation by using Laplace transformation: **(10+10=20)**

(i) $y''(t) - 3y'(t) + 2y(t) = 2e^{-t}, y(0) = 2, y'(0) = -1$.

(ii) $y''(t) - ty'(t) + y(t) = 1, \quad y(0) = 1, y'(0) = 2$.

L-2/T-1/ME **Date : 05/01/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **ME 201** (Basic Thermodynamics)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

All the symbols have their usual meaning.

Assume a reasonable value for any missing data.

Steam Tables add R-134a chart are supplied.

1. (a) Define point function and path function. Show that work is a path dependent function. **(12)**

   (b) Differentiate between reversible and irreversible process. What are the main causes that render irreversibility in a system? **(10)**

   (c) Define 0^{th} law of thermodynamics. Explain its importance. **(7)**

   (d) A spherical balloon contains air at $P_1 = 150$ kPa is placed in vacuum. It has an initial diameter of $D_1 = 0.3$ m. The balloon is heated until its diameter is $D_2 = 0.4$ m. Consider pressure in the balloon is proportional to its diameter, calculate the work of expansion. **(17⅔)**

2. (a) State the 'First Law of Thermodynamics'. Prove that energy is a thermodynamic property. **(8)**

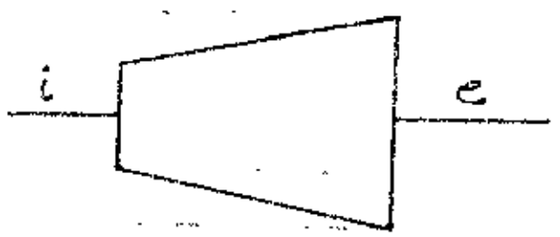
   (b) Explain clearly the difference between a non-flow and a steady flow process. Write down the general energy equation for steady flow system and simplify it when applied for the following systems: **(17)**

   (i) Centrifugal water pump
   (ii) Steam nozzle
   (iii) Gas Turbine

   (c) What do you mean by "perpetual motion machine of first kind (PMM-1)"? **(7)**

   (d) Given a steam turbine with $\dot{m} = 1.5$ kg/s, $Q_{CV} = -8.5$ kW with the following inlet and exit conditions: **(14⅔)**

   $P_i = 2$ MPa; $T_i = 350^\circ$C; $V_i = 50$ m/s; $z_i = 6$ m.
   $P_e = 0.1$ MPa; $x_e = 1$; $V_e = 200$ m/s; $z_e = 3$ m



Find the output power.

Contd P/2

ME 201/ME

3. (a) Give the following statements of second law of thermodynamics: **(8)**

   (i) Clausius statement

   (ii) Kelvin-Planck statement

   (b) Derive an expression for the efficiency of the reversible heat engine. **(4)**

   (c) What is entropy? Given an expression for entropy changes for an open system. **(10)**

   (d) A 0.3 kg metal bar initially at 1200 K is removed from an oven and quenched by immersing it in a closed tank containing 9 kg of water initially at 300 K. Each substance can be modeled as incompressible. An appropriate constant heat value for the water is C_w = 4.2 kJ/kg.k and an appropriate value for the metal is C_m = 0.42 kJ/kg.k. Heat transfer from the tank contents can be neglected. Determine: **(24⅔)**

   (i) the equilibrium temperature of the metal bar and the water and

   (ii) the amount of entropy produced.

4. (a) Explain the concept of 'Exergy'. When does the system become dead? **(8)**

   (b) Derive the Maxwell relations and explain their importance in thermodynamics. **(12)**

   (c) Superheated water vapor enters a valve at 3.0 MPa and exits at a pressure of 0.5 MPa. The expansion is a throttling process. Determine the specific flow exergy at the inlet and exit and the exergy destruction per unit of mass flowing. Let T_0 = 25°C and P_0 = 1 atm. **(24⅔)**

SECTION – B

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

P-h Chart for R-134a and steam tables are supplied.

Assume standard data if necessary.

Symbols have their usual meaning.

5. (a) What do you understand by a "Stoichiometric" mixture? Briefly explain why "Non-Stoichiometric" mixtures are often burnt in real engines and burners. **(10⅔)**

   (b) A sample of dry coal has the following composition by mass: C = 84%, H = 6%, O = 5.5%, N = 1%, S = 0.5% and Ash = 3%. Calculate the required air-fuel ratio by mass when it is burnt with 20% excess air. **(20)**

   (c) Briefly describe a "Stirling Cycle" using schematic, P-V and T-S diagrams. Which is the most important advantage of a Stirling cycle in your opinion? Justify your choice. **(16)**

Contd P/3

ME 201/ME

6. (a) Define absolute humidity. Deduce an expression of absolute humidity in terms of– atmospheric pressure, saturation pressure and relative humidity. Using data from the steam table calculate the absolute humidity for a room condition of 30°C and 70% RH. **(20⅔)**

(b) Define "Ton of Refrigeration". A vapour compression refrigeration cycle using R-134a operates with an evaporator temperature of –10°C as dry saturated vapour and at a condensing temperature of 40°C with 10° of subcooling. For a cooling capacity of 20 Tons, determine **(26)**

(i) COP and EER.

(ii) Mass flow rate of refrigerant in kg/s.

(iii) Required compressor power in kW.

[Draw the cycle on the p-h chart supplied]

7. (a) Using P-V and T-S diagrams explain why the combustion in a SI engine approaches constant volume combustion, while combustion in a CI engine approaches a constant pressure case. **(16)**

(b) Define MEP. State its typical values for SI and CI engine. **(6⅔)**

(c) An ideal diesel cycle has a compression ratio of 18 and a cutoff ratio of 2. The displacement volume of the engine is 1800 cc. Considering air-standard analysis with initial condition of 27°C and 100 kPa. Calculate— **(24)**

(i) Temperatures at the end of each process

(ii) Net work output

(iii) MEP.

8. (a) What do you understand by "Regeneration" in a GT cycle? Deduce an expression of thermal efficiency in an ideal GT cycle with regeneration. Briefly state the influence of pressure ratio on such a cycle. **(22⅔)**

(b) An ideal regenerative Rankine cycle operates with the steam entering the turbine of 30 bar and 500°C and is finally exhausted at 0.2 bar. An OFWH is used for regeneration which operates at 5 bar. Using the steam table supplied calculate— **(24)**

(i) Thermal efficiency (ii) SSC, of the cycle.

SATURATED STEAM - TEMPERATURE TABLE

T °C	P bar	Spec vol. m^3=kg Sat liq v_f X1000	Spec vol. m^3=kg Sat vap. v_g	Int Ener kJ/kg Sat. liq. u_f	Int Ener kJ/kg Sat vap u_g	Enthalpy kJ/kg Sat. liq h_f	Enthalpy kJ/kg Sat vap h_g	Entropy kJ=(kg°K) Sat. liq s_f	Entropy kJ=(kg°K) Sat vap s_g
0.01	0.0061	1.0002	206.1	0.01	2376	0.01	2501	0	9 156
4	0 0081	1.0001	157 2	16.79	2381	16 79	2509	0 061	9.051
5	0 0087	1.0001	147 1	21 00	2383	21	2511	0.0762	9 026
6	0 0093	1.0001	137.7	25.21	2384	25.21	2512	0.0912	9 000
8	0 0107	1.0001	120 9	33 61	2387	33.61	2516	0.1212	8 950
10	0.0123	1 0001	106.4	42.01	2389	42.01	2520	0 151	8 901
11	0 0131	1 0001	99.86	46.19	2391	46.19	2522	0.1658	8.876
12	0.0140	1 0001	93 79	50.40	2392	50.4	2523	0 1806	8 852
13	0.0150	1 0001	88.13	54.59	2393	54.59	2525	0 1953	8.828
14	0 0160	1.0001	82.85	58 80	2394	58 8	2527	0 2099	8 805
15	0.0170	1.0001	77 93	62 99	2396	62 99	2529	0 2245	8.781
16	0 0182	1.0013	73 34	67.17	2397	67.17	2531	0 239	8 758
17	0 0194	1 0013	69 05	71 36	2399	71.36	2533	0 2535	8 735
18	0 0206	1.0013	65 04	75.57	2400	75.57	2534	0.2679	8 712
19	0 0220	1.0013	61 30	79 76	2401	79 76	2536	0.2823	8 690
20	0.0234	1 002	57.79	83 94	2403	83 94	2538	0.2966	8.667
21	0 0249	1 002	54.52	88 13	2404	88.13	2540	0.3108	8 645
22	0 0264	1 002	51.45	92.32	2406	92.32	2542	0.3251	8.623
23	0.0281	1.0026	48 58	96.50	2407	96.5	2544	0.3392	8 601
24	0 0298	1 0026	45 89	100.7	2409	100.7	2545	0 3533	8.579
25	0.0317	1.0032	43 36	104 9	2410	104.9	2547	0.3673	8.558
26	0 0336	1.0032	41 00	109 0	2411	109.0	2549	0.3814	8 537
27	0 0357	1 0032	38.78	113.2	2412	113.2	2551	0 3953	8.515
28	0 0378	1.0038	36 69	117.4	2414	117 4	2553	0 4093	8.495
29	0 0401	1 0038	34.73	121.6	2415	121.6	2554	0.4231	8 474
30	0.0425	1 0045	32.90	125.8	2416	125 8	2556	0 4369	8.453
31	0 0450	1 0045	31.17	130.0	2418	130 0	2558	0.4507	8.433
32	0.0476	1.0051	29.54	134.1	2419	134 1	2560	0.4644	8 413
33	0 0503	1.0051	28 01	138 3	2421	138 3	2562	0.478	8 393
34	0 0532	1 0057	26 57	142 5	2422	142 5	2563	0 4917	8.373
35	0 0563	1 0057	25 22	146 7	2423	146 7	2565	0 5053	8.353
36	0 0595	1 0063	23 94	150 8	2425	150.8	2567	0.5188	8.333
38	0 0663	1 007	21.60	159.2	2427	159.2	2571	0.5457	8 295
40	0 0738	1 0076	19 52	167.5	2430	167 5	2574	0.5725	8 257
45	0 0959	1.010	15 26	188.4	2437	188 4	2583	0.6386	8 165
50	0.1235	1 012	12 03	209.3	2443	209.3	2592	0.7037	8.076
55	0.1576	1.015	9.569	230.2	2450	230 2	2601	0.7679	7.991
60	0.1994	1.017	7 671	251 1	2457	251.1	2610	0 8311	7 910
65	0 2503	1 020	6.197	272 0	2463	272 0	2618	0 8934	7.831
70	0 3119	1.023	5 042	293 0	2470	293 0	2627	0 9549	7 755
75	0 3858	1 026	4 131	313 9	2476	313.9	2635	1.016	7 682
80	0 4739	1.029	3 407	334 8	2482	334 9	2644	1.075	7 612

SATURATED STEAM - TEMPERATURE TABLE (Continued)

T °C	P bar	Spec. vol m^3=kg Sat. liq v_f X1000	Spec. vol m^3=kg Sat vap. v_g	Int Ener. kJ/kg Sat liq. u_f	Int Ener. kJ/kg Sat vap. u_g	Enthalpy kJ/kg Sat liq h_f	Enthalpy kJ/kg Sat. vap h_g	Entropy kJ=(kg°K) Sat. liq s_f	Entropy kJ=(kg°K) Sat. vap s_g
85	0 5783	1 033	2.828	355 B	2488	355 9	2652	1 134	7.544
90	0.7013	1.036	2 361	376.8	2494	376.9	2660	1 193	7 479
95	0 8455	1.039	1.982	397 9	2501	398.0	2668	1.250	7.416
100	1.013	1.044	1.673	418.9	2507	419.0	2676	1 307	7 355
110	1.433	1.052	1.21	461.1	2518	461.3	2691	1.418	7.239
120	1.985	1 060	0.892	503 5	2529	503 7	2706	1.528	7 130
130	2.701	1.069	0 669	546 0	2540	546.3	2720	1 634	7 027
140	3.613	1.080	0 509	588.7	2550	589 1	2734	1 739	6 930
150	4 758	1.091	0 393	631.7	2559	632.2	2746	1 842	6 838
160	6.178	1 102	0 307	674.9	2568	675.5	2758	1.943	6.750
170	7.916	1.114	0 243	718.3	2576	719.2	2769	2 042	6 666
180	10.02	1.127	0.194	762 1	2584	763 2	2778	2 140	6.586
190	12.54	1.141	0.157	806 2	2589	807 6	2786	2.236	6 508
200	15.54	1 156	0.127	850 6	2596	852 4	2793	2 331	6 432
210	19.06	1.172	0.104	895.5	2600	897 8	2798	2.425	6 358
220	23 18	1 190	0.086	940 8	2603	943 6	2802	2 518	6 286
230	27 95	1 209	0 072	986.7	2603	990.1	2804	2.610	6 215
240	33.44	1.229	0 06	1033	2603	1037.3	2804	2.702	6 144
250	39 73	1 251	0.05	1080	2603	1085 3	2802	2.793	6 073
260	46.88	1 275	0 042	1128	2600	1134.4	2797	2 884	6 002
270	54.98	1.302	0 036	1177	2592	1184.5	2790	2.975	5 930
280	64.11	1.332	0 03	1227	2587	1236 0	2780	3 067	5 857
290	74 36	1 365	0 026	1279	2573	1289 D	2766	3 159	5.782
300	85.81	1.403	0 022	1332	2560	1344 0	2749	3 253	5.704
320	112 7	1.499	0 015	1445	2531	1461.5	2700	3.448	5.536
340	145 9	1 638	0 011	1570	2462	1594.1	2622	3.659	5 336
360	186.5	1.893	0 007	1725	2351	1760 5	2481	3.915	5 053
374.14	220 9	3.155	0.003155	2030	2030	2099.3	2099	4.430	4.430

SATURATED STEAM - PRESSURE TABLE

		Spec vol m^3=kg		Int. Ener kJ/kg		Enthalpy kJ/kg		Entropy kJ=(kg°K)	
P bar	T °C	Sat. liq v_f X1000	Sat vap v_g	Sat liq. u_f	Sat vap. u_g	Sat liq h_f	Sat. vap h_g	Sat liq s_f	Sat vap s_g
0 04	28.96	1 004	34 80	121.4	2415	121.4	2554	0.423	8 475
0 06	36 16	1 006	23.75	151 5	2425	151 5	2567	0 521	8.331
0.08	41 5	1 008	18.11	173 8	2432	173 8	2577	0.593	8 229
0 1	45.8	1.010	14 68	191.8	2438	191.8	2585	0 649	8.150
0 2	60 07	1 017	7 649	251 4	2457	251.4	2610	0.832	7 908
0 3	69.11	1 023	5 229	289 2	2468	289.2	2625	0.944	7 769
0.4	75 87	1 026	3.994	317.5	2477	317 6	2637	1.026	7 670
0 5	81.33	1.030	3.240	340 4	2484	340.5	2646	1 091	7 594
0.6	85.94	1 033	2.732	359 8	2490	359 9	2653	1.145	7 532
0.7	89 95	1.036	2 365	376 6	2494	376 7	2660	1 192	7 480
0 8	93 5	1 039	2 087	391 6	2499	391.7	2666	1 233	7.435
0 9	96 71	1.041	1 870	405 1	2503	405.1	2671	1.270	7 395
1	99 62	1.043	1 694	417.3	2506	417 4	2675	1.303	7.359
1.5	111.4	1.053	1.159	466 9	2520	467.1	2694	1.434	7 223
2	120 2	1 061	0 886	504.5	2530	504 7	2707	1.530	7.127
3	133 6	1 073	0 606	561.1	2544	561.5	2725	1 672	6.992
4	143 6	1 084	0 463	604 3	2554	604 8	2739	1 777	6 896
5	151 9	1 093	0 375	639.7	2561	640 2	2749	1.861	6.821
6	158.9	1.101	0 316	669 9	2567	670 6	2757	1 931	6 760
7	165 0	1.108	0 273	696.4	2573	697 2	2764	1.992	6.708
8	170.4	1.115	0 240	720 2	2577	721 1	2769	2.046	6 663
9	175 4	1 121	0 215	741 8	2580	742 8	2774	2 095	6.623
10	179 9	1 127	0 194	761.7	2584	762 8	2778	2 139	6 586
20	212 4	1 177	0 100	906 4	2600	908 8	2800	2 447	6 341
30	233 9	1 217	0.067	1005	2604	1008	2804	2.646	6 187
40	250.4	1.252	0 050	1082	2602	1087	2801	2.796	6 070
50	264 0	1.286	0 039	1148	2597	1154	2794	2.920	5 973
60	275 6	1 319	0 032	1205	2590	1213	2784	3 027	5 889
70	285.9	1 352	0.027	1258	2580	1267	2772	3 121	5.813
80	295 1	1 384	0 024	1306	2570	1317	2758	3 207	5.743
90	303.4	1.418	0 021	1350	2558	1363	2742	3 286	5.677
100	311 1	1 453	0 018	1393	2545	1408	2725	3.360	5 614
110	318 2	1.489	0 016	1434	2530	1450	2706	3.429	5 553
120	324.8	1.527	0.014	1473	2513	1491	2685	3.496	5 492
130	331.0	1 567	0 013	1511	2496	1532	2662	3 561	5 432
140	336 8	1.611	0.012	1549	2477	1571	2638	3 623	5 372
150	342 3	1.658	0 010	1586	2456	1611	2611	3 685	5 310
160	347 4	1.711	0 009	1623	2432	1650	2581	3 746	5 246
170	352.4	1.770	0 008	1660	2405	1690	2547	3 808	5.178
180	357 0	1.839	0 008	1699	2375	1732	2510	3 871	5.105
190	361·5	1.924	0.007	1740	2338	1776	2465	3 938	5 024
200	365 8	2 036	0 006	1786	2295	1826	2411	4 013	4.931
220 9	374 1	3 155	0.003	2030	2029	2099	2099	4.430	4.430

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

	P= 0.06 bar				P= 0 35 bar			
T	v	u	h	s	v	u	h	s
80	27.13	2487	2650	8 580	4 625	2484	2646	7 756
100	28 68	2516	2688	8 685	4 895	2513	2684	7 863
120	30 22	2545	2726	8 784	5 163	2542	2723	7 964
160	33 30	2603	2802	8 969	5.696	2601	2801	8 152
200	36 38	2661	2880	9.140	6 228	2660	2878	8 324
240	39 46	2721	2958	9.298	6 757	2720	2957	8 483
280	42.54	2782	3037	9 446	7.286	2781	3036	8.631
320	45 62	2843	3117	9.586	7 814	2843	3116	8 771
360	48.69	2905	3198	9.718	8 341	2905	3197	8.903
400	51 77	2969	3280	9.843	8 872	2969	3279	9 029
450	55 62	3050	3383	9.992	9.532	3049	3383	9.178
500	59 47	3132	3489	10.13	10 19	3132	3489	9 319

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

	P= 0 7 bar				P= 1 bar			
T	v	u	h	s	v	u	h	s
100	2 434	2510	2680	7.534	1 695	2506	2676	7.361
120	2 571	2540	2720	7.637	1 793	2537	2717	7 467
160	2 841	2599	2798	7.828	1 984	2598	2796	7 660
200	3 108	2659	2877	8 001	2.172	2658	2875	7.834
240	3 374	2719	2956	8 161	2.359	2719	2954	7 995
280	3 639	2780	3035	8 310	2.545	2780	3034	8.144
320	3 904	2842	3115	8 450	2.730	2842	3115	8 285
360	4 170	2905	3196	8 583	2 917	2904	3196	8.417
400	4.434	2968	3279	8.708	3 102	2968	3278	8.543
450	4 764	3049	3383	8 858	3 334	3049	3382	8 693
500	5.094	3132	3488	8.999	3 565	3132	3488	8 834
550	5 423	3213	3593	9.129	3.796	3216	3596	8 969
600	5.753	3298	3701	9 257	4 027	3302	3705	9 097

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

	P= 1.5 bar				P= 3 bar			
T	v	u	h	s	v	u	h	s
120	1 188	2533	2711	7 269	XXX	XXX	XXX	XXX
160	1 317	2595	2793	7.466	0 6506	2587	2782	7 128
200	1 444	2656	2873	7.643	0.7162	2651	2866	7.311
240	1.570	2717	2953	7.805	0 7802	2713	2947	7.477
280	1 694	2779	3033	7.955	0.8438	2775	3029	7 630
320	1.819	2841	3113	8.096	0.9067	2838	3110	7 772
360	1.943	2903	3195	8.229	0.9692	2901	3192	7 906
400	2 067	2967	3277	8 355	1 031	2966	3275	8 033
450	2.221	3048	3382	8 505	1.109	3047	3380	8.183
500	2 376	3131	3488	8 646	1.186	3130	3486	8 325
550	2.530	3216	3595	8.781	1 264	3215	3594	8 460
600	2.684	3302	3704	8.910	1.341	3301	3703	8.589

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

	P= 5 bar				P= 7 bar			
T	v	u	h	s	v	u	h	s
160	0 3836	2576	2767	6 865	XXX	XXX	XXX	XXX
200	0.4249	2643	2855	7.059	0 2999	2635	2845	6 886
240	0 4644	2708	2940	7.230	0.3292	2702	2932	7 064
280	0 5034	2771	3023	7.386	0 3574	2767	3017	7 223
320	0.5416	2835	3105	7.531	0.3852	2831	3101	7.370
360	0 5795	2899	3188	7 666	0 4125	2896	3185	7 506
400	0 617	2963	3272	7 793	0.4397	2961	3269	7.635
450	0.6642	3045	3377	7.945	0.4735	3043	3375	7.787
500	0.7109	3128	3484	8 087	0 507	3127	3482	7.930
550	0.7575	3213	3592	8.223	0 5405	3212	3590	8.066
600	0.8041	3300	3702	8 352	0 5738	3298	3700	8 195
650	0 8505	3388	3813	8 476	0.6071	3387	3812	8 320
700	0 8969	3477	3926	8 595	0.6403	3477	3925	8 439

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

	P= 10 bar				P= 15 bar			
T	v	u	h	s	v	u	h	s
200	0.2059	2622	2828	6.694	0.1325	2598	2797	6.455
240	0 2275	2693	2920	6 882	0.1482	2677	2899	6 663
280	0.248	2760	3008	7.046	0.1627	2749	2993	6.838
320	0.2678	2826	3094	7 196	0 1765	2817	3082	6 994
360	0.2873	2892	3179	7 335	0.1899	2884	3169	7.136
400	0.3066	2957	3264	7 465	0 203	2951	3256	7 269
450	0 3304	3040	3371	7.618	0.2192	3035	3364	7 424
500	0 3541	3124	3478	7.762	0 2352	3120	3473	7 570
550	0 3776	3210	3587	7 899	0 251	3206	3583	7.707
600	0 4011	3297	3698	8 029	0 2668	3294	3694	7.838
650	0.4245	3385	3810	8.153	0.2825	3383	3806	7 964
700	0 4478	3475	3923	8.273	0 2981	3473	3920	8 084

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

	P= 20 bar				P= 30 bar			
T	v	u	h	s	v	u	h	s
240	0 1084	2660	2876	6 495	0 0682	2620	2824	6 226
280	0 12	2736	2976	6 683	0 0771	2710	2941	6 446
320	0 1308	2808	3069	6 845	0.085	2788	3043	6 624
360	0 1411	2877	3159	6 992	0 0923	2862	3139	6.780
400	0 1512	2945	3248	7.127	0.0994	2933	3231	6.921
450	0 1635	3030	3357	7 284	0 1079	3020	3344	7 083
500	0 1757	3116	3468	7 432	0 1162	3108	3456	7 234
550	0.1877	3203	3578	7 570	0 1244	3196	3569	7 375
600	0 1996	3291	3690	7.702	0 1324	3285	3682	7 508
650	0.2114	3380	3803	7 828	0 1404	3375	3796	7.636
700	0.2232	3471	3917	7 949	0 1484	3466	3912	7.757

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

P= 40 bar					P= 60 bar			
T	v	u	h	s	v	u	h	s
280	0 0555	2680	2902	6 257	0.0332	2605	2804	5.925
320	0.062	2767	3015	6.455	0 0387	2720	2952	6.184
360	0 0679	2846	3117	6 621	0.0433	2811	3071	6.378
400	0 0734	2920	3213	6 769	0 0474	2893	3177	6.541
450	0.08	3010	3330	6.936	0 0521	2989	3302	6 719
500	0.0864	3100	3445	7 090	0.0567	3082	3422	6.880
550	0 0927	3189	3560	7 233	0 061	3175	3541	7.029
600	0 0988	3279	3674	7.369	0.0653	3267	3658	7 168
650	0.1049	3370	3790	7.497	0 0694	3360	3776	7 299
700	0 1109	3462	3906	7 620	0 0735	3453	3894	7.423
750	0.1169	3556	4023	7.737	0 0776	3547	4013	7 542

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

P= 80 bar					P= 100 bar			
T	v	u	h	s	v	u	h	s
320	0 0268	2663	2877	5.949	0 0193	2588	2781	5 710
360	0 0309	2773	3020	6.182	0 0233	2729	2962	6 006
400	0 0343	2864	3138	6.363	0.0264	2832	3096	6.212
450	0 0382	2966	3272	6 555	0.0297	2944	3241	6 419
500	0 0417	3065	3398	6.724	0 0328	3046	3374	6 597
550	0 0451	3160	3521	6.878	0 0356	3145	3501	6 756
600	0 0485	3254	3642	7 020	0 0384	3241	3625	6.903
650	0 0517	3349	3762	7.154	0 041	3338	3748	7 040
700	0 0548	3444	3882	7 281	0 0436	3434	3870	7 169
750	0.0579	3540	4003	7 402	0 0461	3532	3993	7.291

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

P= 120 bar					P= 140 bar			
T	v	u	h	s	v	u	h	s
360	0 0181	2678	2896	5 836	0 0142	2618	2816	5.660
400	0 0211	2798	3051	6.075	0 0172	2761	3002	5.945
450	0 0241	2919	3208	6 300	0 0201	2893	3174	6.192
500	0 0268	3027	3348	6 487	0 0225	3007	3322	6 390
550	0 0293	3129	3480	6 653	0 0247	3113	3459	6 562
600	0 0316	3229	3608	6 804	0 0268	3216	3591	6 717
650	0 0339	3327	3734	6.944	0 0288	3316	3720	6 860
700	0 0361	3425	3858	7 075	0 0307	3416	3846	6.994
750	0 0382	3524	3982	7.199	0 0326	3515	3972	7.120
800	0 0403	3611	4095	7 305	0 0344	3604	4085	7.227

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg°K)

P= 160 bar					P= 180 bar			
T	v	u	h	s	v	u	h	s
360	0.0111	2538	2716	5.461	0 0081	2418	2564	5 192
400	0 0143	2719	2948	5.817	0 0119	2673	2887	5 689
450	0 017	2866	3138	6.091	0 0146	2837	3100	5 995
500	0.0193	2986	3295	6 301	0 0168	2965	3267	6.218
550	0 0213	3097	3438	6 480	0.0187	3079	3416	6.405
600	0 0232	3202	3573	6.640	0.0204	3188	3556	6.570
650	0 025	3305	3705	6 786	0 0221	3292	3690	6 719
700	0 0267	3407	3834	6 922	0.0236	3397	3821	6 858
750	0 0284	3507	3961	7.050	0 0251	3499	3951	6 988
800	0 03	3608	4088	7 171	0 0266	3600	4079	7 110

SUPERHEATED STEAM

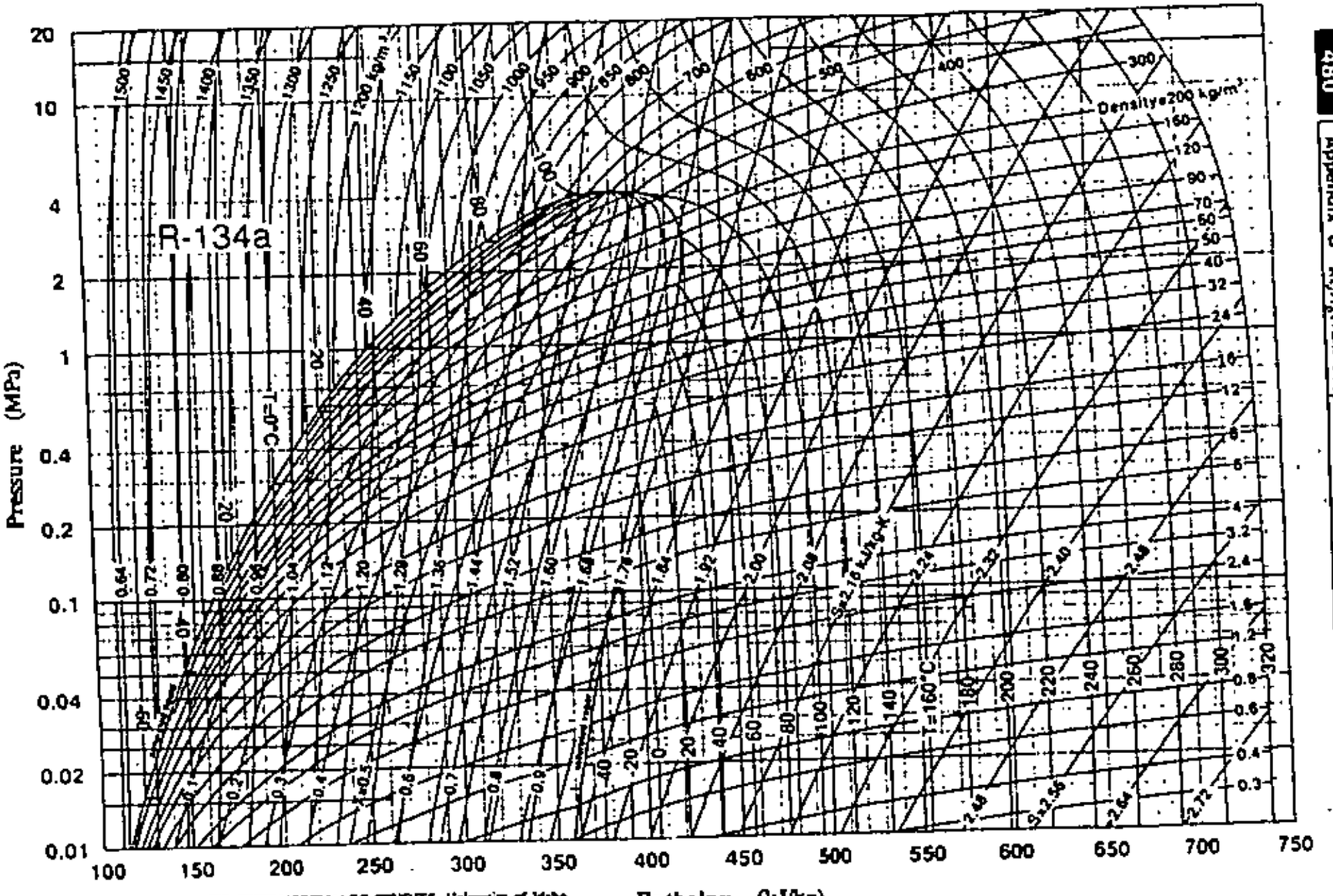
v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg^0K)

	P= 200 bar				P= 240 bar			
T	v	u	h	s	v	u	h	s
400	0 0099	2620	2818	5 554	0 0067	2479	2639	5 239
450	0 0127	2806	3060	5.902	0 0098	2738	2973	5.720
500	0 0148	2942	3239	6 140	0 0117	2897	3178	5 994
550	0 0166	3061	3393	6 335	0 0134	3026	3347	6 207
600	0 0182	3174	3538	6.505	0.0148	3145	3501	6 387
650	0 0197	3281	3675	6 658	0.0161	3259	3645	6.548
700	0 0211	3387	3809	6 799	0 0174	3366	3784	6.695
750	0 0225	3490	3940	6.931	0 0186	3473	3919	6 830
800	0 0239	3592	4070	7 054	0.0197	3579	4052	6 957
900	0.0264	3782	4310	7 267	0 0219	3787	4312	7 189

SUPERHEATED STEAM

v in m^3=kg, u in kJ/kg, h in kJ/kg, s in kJ=(kg^0K)

	P= 280 bar				P= 320 bar			
T	v	u	h	s	v	u	h	s
400	0 0038	2224	2331	4 749	0.0024	1979	2056	4.324
450	0 0076	2662	2875	5 537	0 006	2572	2764	5.346
500	0 0096	2845	3114	5.857	0 0079	2794	3047	5.725
550	0 0111	2989	3300	6 090	0 0094	2950	3251	5 987
600	0.0124	3116	3463	6 282	0 0106	3085	3425	6 186
650	0 0136	3234	3614	6 451	0 0117	3209	3583	6 363
700	0 0147	3347	3758	6 603	0 0127	3326	3733	6.520
750	0 0158	3455	3898	6 742	0 0137	3438	3876	6 664
800	0 0168	3563	4033	6 872	0 0146	3548	4015	6 797
900	0 0187	3775	4299	7.108	0 0163	3763	4285	7.037



Prepared by CENTER FOR APPLIED THERMODYNAMIC STUDIES, University of Idaho

FIGURE B1 Pressure-enthalpy diagram for refrigerant R134a.

L-2/T-1/ME Date : 10/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **EEE 259** (Electrical and Electronic Technology)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Students are advised to keep their answers concise.

1. (a) Drive the relationship between phase and line voltages and currents for a delta (Δ) connection. **(8⅓)**

   (b) Describe the two-wattmeter method for measuring three-phase power. **(20)**

   (c) The two-wattmeter method produces wattmeter readings P_1 = 1560 W and P_2 = 2100 W when connected to a delta-connected load. If the line voltage is 220 V, calculate–

   (i) the per-phase average power **(4)**

   (ii) the per-phase reactive power **(4)**

   (iii) the power factor **(4)**

   (iv) the phase impedance **(6)**

2. (a) Establish the expression describing the apparent power rating advantage of an autotransformer over a conventional transformer. **(10)**

   (b) A 5000-VA, 480/120-V conventional transformer is to be used to supply power from a 600-V source to a 120-V load. Consider the transformer to be ideal, and assume that all iusulation can handle 600-V.

   (i) Sketch the transformer connection that will do the required job. **(4)**

   (ii) Find the kVA rating of the transformer in the configuration. **(3⅓)**

   (iii) Find the maximum primary and secondary currents under these couditions. **(4)**

   (c) Three 25-kVA, 24000/277-V distribution transformers are connected in Δ-Y. The open-circuit test was performed on the low voltage side of this transformer bank and the short-circuit test was performed on the high voltage side of this transformer bank. The following data were recorded:

   Open Circuit Test: $V_{line,\,OC}$ = 480 V; $I_{line,\,OC}$ = 4.10 A; $P_{3\phi,\,OC}$ = 945 W

   Short Circuit Test: $V_{line,\,SC}$ = 1600 V; $I_{line,\,SC}$ = 2.00 A; $P_{3\phi,\,SC}$ = 1150 W

Contd P/2

EEE 259/ME

Contd... Q. No. 2(c)

(i) Find the per-unit equivalent circuit of this transformer bank. **(15)**

(ii) Find the voltage regulation of this transformer bank at the rated load and 0.90 PF lagging. **(5)**

(iii) What is the efficiency of this transformer bank under the condition in part (ii)? **(5)**

3. (a) Describe the effect of load change on a synchronous generator operating alone at leading pf with the help of phasor diagrams. **(10)**

(b) What is an infinite bus? What constraints does it impose on a generator paralleled with it? **(6⅔)**

(c) How can the real power sharing between two generators be controlled without affecting the system frequency? Explain with the help of house diagram. **(10)**

(d) Two generators are supplying a real load totaling 2.5 MW at 0.8 PF lagging. Generator-1 has a no-load frequency of 61.5 Hz and a slope S_{p1} of 1 MW/Hz. Generator-2 has a no-load frequency of 61.0 Hz and a slope S_{p2} of 1 MW/Hz.

(i) At what frequency is this system operating, and how much power is supplied by each of the two generators? **(6)**

(ii) Suppose an additional 1-MW load were attached to this power system. What would the new system frequency be, and how much power would Gen-1 and Gen-2 supply? **(7)**

(iii) What action could an operator take so that the real power is shared equally by Gen-1 and Gen-2, and the system frequency would remain unchanged? **(7)**

4. (a) "If a three-phase set of currents, each of equal magnitude and differing in phase by 120°, flows in a three-phase winding, then it will produce a rotating magnetic field of constant magnitude" – prove. **(15)**

(b) Explain, using phasor diagram, what happens to a synchronous motor as its field current is varied. Derive the synchronous motor V-curve from the phasor diagram. **(15⅔)**

(c) A 208-V, 45-kVA, 0.8 pf-leading, Δ-connected, 60 Hz synchronous machine has a synchronous reactance of 2 5 Ω and a negligible armature resistance. Its friction and windage losses are 1.5 kW, and its core losses are 1.0 kW. Initially, the shaft is supplying a 15-hp load, and the motor's power factor is 0.80 leading.

(i) Find the values of I_A, $|I_L|$ and E_A. **(8)**

(ii) Assume that the shaft load is now increased to 30 hp. Find I_A, $|I_L|$ and E_A after the load change. What is the new motor power factor? **(8)**

Contd ..... , P/3

EEE 259/ME

SECTION – B

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

5. (a) Derive the induced-torque equation of a induction motor. **(23)**

(b) A 460 V, 25 Hp, 60 Hz, four pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator circuit: **(23⅓)**

$R_1 = 0.641\ \Omega$ $R_2 = 0.332\ \Omega$

$X_1 = 1.106\ \Omega$ $X_2 = 0.464\ \Omega$ $X_M = 26.3\ \Omega$

The total rotational losses are 1100 W and are assumed constant. The core loss is lumped in with the rotational losses. The rated speed of the motor is 1760 rpm. At rated voltage and frequency, find the motor's: **(20)**

(i) Slip

(ii) Stator current

(iii) Power factor

(iv) τ_{ind} and τ_{load} (τ denotes torque)

(v) Efficiency.

6. (a) Derive the expression for the terminal characteristic of a shunt DC motor. Using that expression discuss various speed control method for shunt DC motors. **(20)**

(b) Draw the equivalent circuit for the following DC motors: **(12)**

(i) Separately excited DC motor

(ii) Shunt DC motor

(iii) Series DC motor

(iv) Cumulatively compounded DC motor.

(c) A duplex lap-wound armature is used in a six-pole DC machine with six brush sets, each spanning two commutator segments. There are 72 coils on the armature, each containing 12 turns. The flux per pole in the machine is 0.039 Wb, and the machine spins at 400 rpm. Calculate– **(14⅔)**

(i) How many current paths are there in this machine?

(ii) What is its induced voltage E_A.

Contd P/4

EEE 259/ME

7. (a) Assume that the diodes in the circuit of Fig. for Q. No. 7(a) are ideal. For the circuit– **(20)**

   (i) Derive the expression for transfer-characteristics

   (ii) Sketch the transfer-characteristics

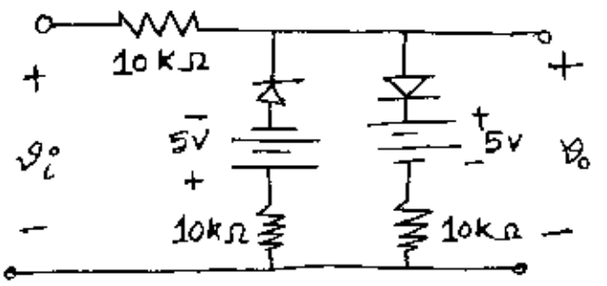


Fig. for Q. No. 7(a)

(b) In the circuit of Fig. for Q. No. 7(b), the NMOS transistor has $V_t = 0.9$ V and $V_A = 50$ V, and operates with $V_D = 2$ V. Find– **(26⅔)**

   (i) Small signal equivalent circuit.

   (ii) Voltage gain, $A_v = v_o/v_i$.

   (iii) Voltage gain A_v and DC voltage at drain V_D, if I increased to 1 mA.

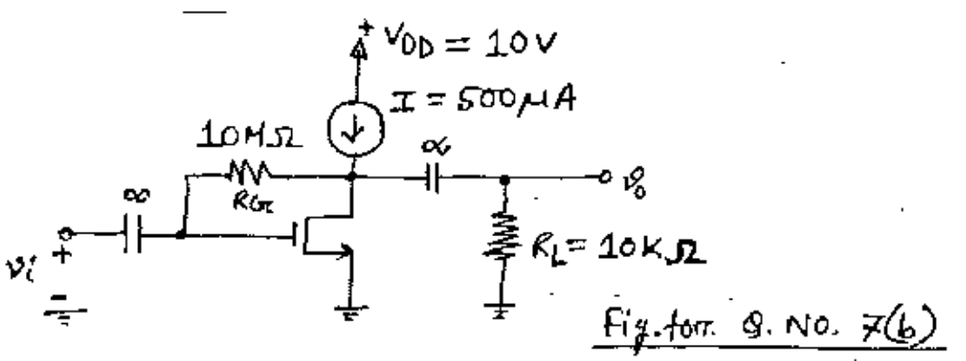


Fig. for Q. No. 7(b)

8. (a) Analyze the circuit of Fig. for Q. No 8(a) to determine the voltages at all Nodes (V_G, V_D, V_S) and current through all branches. Let, $V_t = 1$ V and $k_n'(W/L) = 1$ mA/V^2. **(23)**

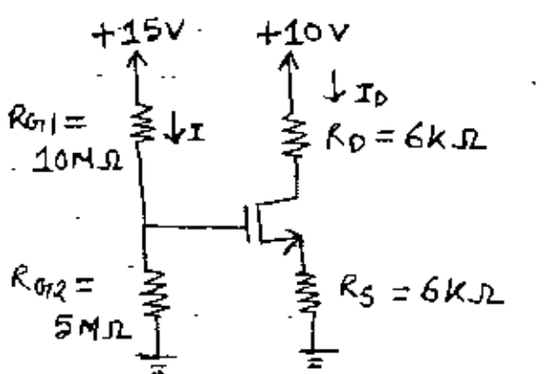


Fig. for Q. No. 8(a)

Contd P/5

EEE 259/ME

Contd... Q. No. 8

(b) In the circuit of Fig. for Q. No. 8(b), the emitter voltage is 1.0 V. Find out– (23⅓)

(i) V_B, V_C

(ii) I_B, I_E, I_C

(iii) α, β

Here, all symbol represents usual meaning.

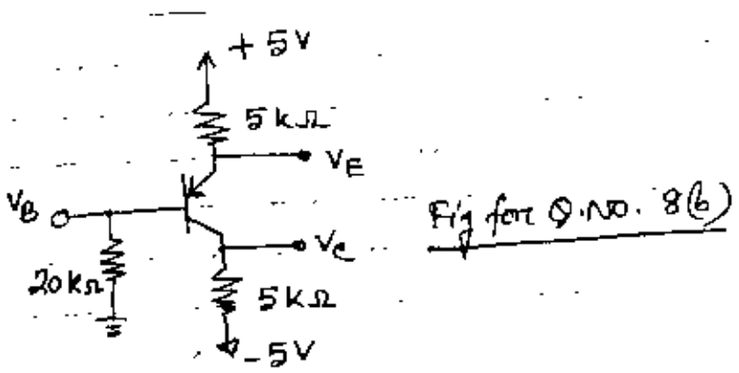


Fig for Q.No. 8(b)

L-2/T-1/ME Date : 15/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc Engineering Examinations 2013-2014

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) "A variable cost is a cost that varies per unit of product, whereas a fixed cost is constant per unit of product". Do you agree? Explain. **(5)**

(b) Define the following cost concept with example (any four): **(8)**

(i) Non-manufacturing cost.

(ii) Relevant range.

(iii) Committed cost.

(iv) Differential cost.

(v) Prime cost.

(c) The SUSAN Company makes art prints. The following details are available for the year ended 31st December, 2010. **(22)**

	Amount (Tk.)
Opening stock:	
Direct material	26,000
Work-in-process	74,000
Finished goods	120,000
Direct material purchased	436,000
Direct labor	12,000
Indirect labor	44,000
Administrative expenses	160,000
Depreciation on factory equipment	70,000
Selling expenses	140,000
Factory power, heat and light	20,000
Building rent (production uses 80% of the spaces, administration and sales uses the rest)	50,000
Sales promotion	10,000
Sales	100,0000
Utility, factory	5,000
Closing stock:	
Direct material	42,000
Work-in-process	54,000
Finished goods	80,000

Required:

(i) Prepare a cost of goods sold statement.

(ii) Prepare an income statement.

Contd P/2

HUM 303 (ME)

2. (a) What is meant by degree of operating leverage? Why is it calculated? **(5)**

(b) "Sun Flower" company has the following information related to cost structure and other data: **(30)**

Cost data	Amount (Tk.)
Direct material	115
Direct labor	10
Variable manufacturing overhead	5
Total variable cost per unit	130
Total fixed cost	180,000
Selling price per unit	150
Number of units produced and sold	30,000

Required:

(i) Compute break-even-points in units and in amounts.

(ii) Compute degree of operating leverage.

(iii) Prepare a contribution margin format income statement selling price increases by Tk. 2 per unit, fixed cost increases by Tk. 15,000 and sales volume decreases by 10%.

(iv) Compute break-even-points in units if selling price increases by 10% and variable cost increases by 20%.

(v) Compute margin of safety in units and value. (Consider original data)

(vi) Compute number of units sold if target profit is Tk. 500,000. (Consider original data)

(vii) Compute income or loss when 40,000 units is sold and variable cost increases by Tk 5 per unit. (Other information remaining same)

(viii) The company estimates that sales will increase by Tk. 45,000 next year due to increased demand. By how much should net operating income increases (Use CM ration to calculate your answer).

3. (a) What account is created when overhead cost is applied to work-in-process? Would you expect the amount applied for a period to equal the actual overhead costs of the period? Why or why not? **(3)**

(b) The following information is available for "Quality Products Ltd" for the year 2010. The opening inventory account balances were as follows: **(20)**

Raw materials	10,000
Work-in-process	4,000
Finished goods	8,000
Total	22,000

The company applies overhead cost to jobs on the basis of machine-hours. It was estimated that the company would operates 45,000 machines-hours and incur Tk. 99,000 in manufacturing cost. During the year, the following transactions were completed:

Contd P/3

HUM 303 (ME)

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

(i) Raw material purchased on account Tk. 160,000.

(ii) Raw material requisitioned for the use in production Tk. 14,0000 (materials costing Tk. 120.000 were chargeable directly to jobs, remaining were indirect).

(iii) Costs of employee services were as follows:

Direct labor	90,000
Indirect labor	60,000
Sales commissions	20,000
Administrative salaries	50,000

(iv) Prepaid insurance expired during the year was Tk. 18,000 (Tk. 13,000 of this amount related to factory operation and the remainder related to selling and administrative activities).

(v) Utility costs incurred in the factory Tk. 10,000.

(vi) Advertising costs incurred Tk. 15,000.

(vii) Manufacturing overhead cost was applied to production (The company recorded 50,000 machine-hours of operating time during the year).

(viii) Goods that had cost Tk. 310,000 to manufacture according to their job cost sheets were transferred into the finished goods warehouse.

(ix) Sale (all on account) to customers during the year totaled Tk. 498,000. These goods had cost Tk. 308,000 to manufacture according to their job cost sheets.

Required:

- Prepare journal entries to record the transactions for the year 2010.
- Is manufacturing overhead under applied or over applied for the year? Prepare a journal entry to close any balance in the manufacturing overhead account to Cost of goods sold.

(c) Xavier Company produces a single product. Variable manufacturing overhead is applied to products on the basis of direct labor hours. The standard costs for one unit of product for June, 2009 are as follows: **(12)**

Direct material: 6 ounces at $0.50 per ounce	$3
Direct labor: 1.8 hours at $10 per hour	18
Variable manufacturing overhead: 1.8 hours at $5 per hour	9
Total standard variable cost per unit	**$30**

During June, 2000 units were produced. The costs associated with Junes operations were as follows.

Material purchased: 18,000 ounces at $0.60 per ounce	$10,800
Material used in production: 14,000 ounces	---
Direct labor: 4,000 hours at $9.75 per hour	$39,000
Variable manufacturing overhead costs incurred	$20,800

Required: Compute

(i) Direct material variances. (Both quantity and price variance)

(ii) Direct labor variances. (Both rate and efficiency variance)

(iii) Variable manufacturing overhead variance. (Both spending and efficiency variance)

Contd P/4

HUM 303 (ME)

4. (a) Speedy parcel service operates a fleet of delivery trucks in a large metropolitan area. A cost analyst has determined that if a truck is driven 120,000 miles during a year, the average cost is Tk. 11.6 per mile. If a truck is driven only 80,000 miles during a year, the average operating cost increases to Tk. 13.6 per mile. **(9)**

Required:

(i) Using high-low method, estimates the variable and fixed cost elements of the annual cost of truck operation.

(ii) Express the variable and fixed costs in the form $Y = a + bX$.

(iii) If a truck were driven 100,000 miles during a year, what total cost would you expect to be incurred?

(b) What do you meant by Capital Budgeting decision? Mention several typical capital budgeting decisions. **(3)**

(c) What is IRR? How is IRR computed? **(3)**

(d) As a manager of The Heliberton Company, you are going to evaluate following two Projects: named as Project S and Project L. Both projects will require initial cost of Tk. 3,000. The cash flows of the projects, subsequent to the initial year, during their 4-year life time has been presented in below: **(20)**

Year	Project S	Project L
1	Tk. 1,500	Tk. 400
2	1,200	900
3	800	1,300
4	300	1,500

Assume the required rate of return is 10%.

Which project you will accept, if the decision is based on:

(i) Pay-Back Period

(ii) Net Present Value

(iii) Internal Rate of Return

(iv) Profitability Index.

SECTION – B

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

5. (a) Define *Assets* and *Liabilities*. Provide suitable examples also. **(4)**

(b) Can a business enter into a transaction in which only left side of the Basic Accounting Equation is affected? If so, give an example. **(3)**

(c) During the first month of its operations, Tara Care Company has the following transactions: **(28)**

Contd P/5

HUM 303 (ME)

Contd ... Q. No. 5(c)

May 1: Made cash investment of Tk. 12,000 to start business.

May 2: Paid monthly rent of Tk. 800.

May 5: Purchases equipment for Tk. 8,000 on account.

May 8: Billed Tk. 5,300 to customers for services performed.

May 12: The owner withdrew Tk. 1,200 cash from business for paying school fees of child.

May 20: Make a proposal for purchasing a land costing Tk. 10,000.

May 21: Received cash from customers billed in (4).

May 25: Incurred advertising expense of Tk. 550 on account.

May 28: Purchased additional equipment amounting Tk. 6,000 for cash.

May 30: Received Tk. 7,700 cash from customers when service was performed.

Instruction:

Prepare a Tabular Analysis of the transactions using appropriate column headings.

6. (a) A student, unaware of accounting terms, says that debit balances are favorable and credit balances are unfavorable? Do you agree? Explain your argument. **(5)**

(b) Are the following events recorded in the accounting records? Explain your answer in each case: **(6)**

(i) The owner of the company dies.

(ii) Supplies are purchased on account.

(iii) An employee of the company is fired.

(iv) The owner of the business withdraws cash from the business for personal use.

(c) On December 1, 2013 Javed started his business. The direct Delivery, Inc He completed the following transactions during December of the current year. **(24)**

December 1 : Started his product delivery services by investing Tk. 15,000 cash.

December 2: Purchases Tk. 1,200 of office equipment on credit.

December 3: Purchased Tk. 300 supplies with cash.

December 4: Completed work for a client and immediately received Tk. 900 cash

December 8: Completed work for ABC Co. on credit, Tk. 1,700.

December 10: Paid full amount for the purchase of Office Equipment On December 2

December 18: Received payment in half from ABC Co. for the work completed on December 8.

December 27: Javed withdrew Tk. 625 from business for his personal use.

December 30: Paid Tk. 275 cash for utility bills.

December 30: Received a bill for Tk. 550 for advertising for the current month.

Contd P/6

HUM 303 (ME)

Contd ... Q. No. 6(c)

Instructions:

(i) Journalize the following business transactions in general form. Explanations are necessary part of a journal entry.

(ii) Prepare Accounts Receivable and Service Revenue Ledger Account.

7 (a) Why may a trial balance not contain up-to-date and complete financial information? **(5)**

(b) The trial balance columns of the worksheet for Sasse Roofing at March 31, 2014, are as follows: **(30)**

Sasse Roofing

Trial Balance

For the Month Ended March 31, 2014

Account Titles	Debit	Credit
Cash	Tk. 4,500	
Accounts Receivable	3,200	
Supplies	2,000	
Equipment	11,000	
Accumulated Depreciation- Equipment		1,250
Unearned Revenue		550
J. Sasse, Capital		12,900
J. Sasse, Drawing	1,100	
Service Revenue		6,300
Salaries Expense	1,300	
Miscellaneous Expense	400	
	23,500	23,500

Other Data:

→ A physical count reveals only Tk. 650 of supplies on hand.

→ Depreciation for the year is Tk. 3,000.

→ Unearned revenue amounted to Tk. 170 at March 31.

→ Accrued Salaries are Tk. 600.

Instructions:

(i) Prepare the Adjusting Entries for the month of March. You may omit explanations.

(ii) Prepare Adjusted Trial Balance.

(iii) Prepare Income Statement, Owner's Equity statement for the month of March and a Balance Sheet as at March 31, 2014.

Contd P/7

HUM 303 (ME)

8. (a) Mention the importance and limitations of Financial Statement Analysis. **(8)**

(b) Selected financial statement data for Skylark Corporation are presented below: **(27)**

	2014	2013
Net Sales	Tk. 700,000	Tk. 650,000
Cost of Goods Sold	420,000	400,000
Interest Expense	35,000	30,500
Net Income	45,000	30,000
Accounts Receivable	45,000	48,000
Inventory	133,000	115,500
Total Assets	640,000	600,000
Current Liabilities	75,000	80,000
Long Term Debt	80,000	85,000
Total Shareholder's Equity	485,000	435,000
Weighted Average common shares outstanding	34,000	31,000
Market Price of each Share	Tk. 4.00	Tk. 5.00

Additional Information: For 2012, Total Assets was Tk. 533,000; Current liability was Tk. 70,000 and Long Term Debt was Tk. 50,000.

Instructions:

(i) Compute the following ratios for both 2013 and 2014.

- Current Ratio
- Profit Margin
- Return on Total Assets
- Earnings per Share
- Price-Earnings Ratio
- Debt to Assets ratio

(ii) Based on the Ratios calculated, discuss briefly the improvement or lack thereof in financial position and performance of the company from 2013 to 2014.
