L-1/T-2/NAME **Date : 11/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 123** (Fluid Mechanics)

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**.

The symbols have their usual meaning.

Assume reasonable value in case of any missing data.

1. (a) Derive the pipe-friction equation. Show that pressure loss is directly proportional to velocity when the flow is laminar. **(20)**

   (b) A venturimeter with an entrance diameter of 0.3 m and a throat diameter of 0.2 m is used to measure the volume of gas flowing through a pipe. The discharge coefficient of the meter is 0.96. Assuming the specific weight of the gas to be constant at 19.62 N/m^3, calculate the volume flowing when the pressure difference between the entrance and the throat is measured as 0.06 m on a water U-tube manometer. **(15)**

2. (a) Water flows steadily through the 0.75 inch diameter galvanized iron pipe as shown in the Figure 2(a) at a rate of 0.020 cfs. Determine the major head losses and minor head losses. Do you agree that friction losses in the straight pipe section are negligible compare to the losses in the threaded elbows and fittings of the systems? Support your answer with appropriate calculations. Take e = 0.15 mm for galvanized iron. **(25)**

   (b) Write short notes on: **(10)**

   (i) Boundary layer thickness

   (ii) Critical Reynold's number

3. (a) A pipeline carries water around a horizontal 45° bend. The entrance diameter of the bend is 500 mm and the velocity of flow is 1 m/s. The bend tapers gradually to 200 mm diameter at its exit. If the pressure at upstream of the entrance is measured at 200 kN/m^2, what is the force, and its line of action, exerted by the water on the bend? **(20)**

   (b) What is cavitation? How do you reduce the cavitation problem of a pump? Discuss briefly. **(10)**

   (c) Write short notes on hydraulically smooth and rough pipe. **(5)**

4. (a) Blue and yellow streams of paint at 16°C (each with a density of 825 kg/m^3 and viscosity 1000 times that of water) enter a pipe with an average velocity of 1.20 m/s as shown in Figure 4(a). The pipe has a diameter of 5.0 cm. Would you expect the paint to exit the pipe as green paint? Explain. **(15)**

   Repeat the problem if the paint were 'thinned' so that it is only 10 times more viscous then water. Assume that the density remain same and $\mu = 1.13 \times 10^{-3}$ Ns/m^2 for water.

20

Contd P/2

NAME 123

Contd ... Q. No. 4

(b) Two vertical cylindrical tanks of 3 m and 2 m diameter are joined at their base by a pipe of diameter 0.05 m. This pipe is short enough to be treated as an orifice with a co-efficient of discharge of 0.58. The 3 m diameter tank is initially at a level 3 m higher than the other. Working from the first principle, calculate how long it will take for the level difference to half. **(15)**

(c) State Bernoulli's equation. List the assumptions made. **(5)**

SECTION – B

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

Assume reasonable value for missing data if any.

5. (a) What is viscosity of fluid? Derive the equation of viscosity of fluid. In this respect differentiate between Newtonian and non-Newtonian, ideal plastic and elastic solid with examples. Support your answer with proper figures. **(10)**

(b) A space of 25 mm width between two large plane surfaces is filled with SAE 30 Western lubricating oil at 25°C ($\mu = 2.1 \times 10^{-1}$ Ns/m^2). What force is required to drag a very thin plate of 0.35 m^2 area between the surfaces at a speed of 0.1 m/s? **(15)**

(c) Distinguish between: **(10)**

(i) Compressible and Incompressible flow
(ii) Steady and Unsteady flow
(iii) Laminar and Turbulent flow
(iv) Ideal fluid and Real fluid
(v) Uniform and Non-uniform flow

6. (a) An open tank has a vertical partition and on one side contains gasoline with a density P = 700 kg/m^3 at a depth of 4.0 m shown in figure. A rectangular gate that is 4 m high and 2.0 m wide and hinged at one end is located in the partition. Water is slowly added to the empty side of the tank. At what depth, h, will the gate start to open? **(15)**

(b) Models are to be built of the following prototypes. For dynamic similarity, indicate which single dimensionless ratio will govern, give reasons. **(20)**

(i) oil flowing through a full pipeline
(ii) a water jet
(iii) an airplane flying at low speed
(iv) a supersonic aircraft
(v) flow over the spillway of a dam
(vi) a deep submersible vehicle
(vii) a missile (supersonic)
(viii) tides

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NAME 123

7. (a) Water flows from a large tank as shown in figure. Atmospheric pressure is 101,400 pa while the vapor pressure of the water is 12,000 pa. Given that the height, h is 0.30 m, determine: **(20)**

   (i) The flow-rate of water out of the tank

   (ii) The pressure at a point where $D_3 = 4.0$ in.

   (iii) The pressure at the constriction, where $D_1 = 4.0$ in.

   Finally, determine the value of 'h' for which cavitation will begin to occur in the 1.0 in. constriction.

   (b) In the figure, the diameter of the vertical pipe is 10 cm and that of the stream discharging into the air at E is 7 cm. Neglecting all losses of energy, what are the pressure heads at B, C and D? **(15)**

8. (a) Explain the physical significance of Reynold's Number and Froude's Number. **(10)**

   (b) A river barge, whose cross section is approximately rectangular, carries a load of grain. The barge is 28.0 ft wide and 90 ft long. When unloaded it's draft (depth of submergence) is 5.0 ft and with the load of grain the draft is 7.0 ft. Determine: **(5)**

   (i) The unloaded weight of the barge

   (ii) The weight of the grain

   (c) Find the magnitude and direction of the resultant force acting on the curved gate AB. The width of the gate is 2.5 m. **(20)**

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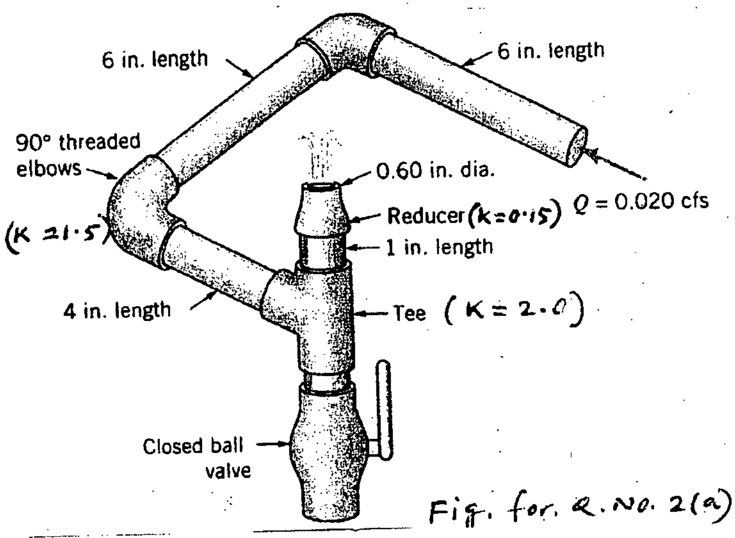

Fig. for Q. No. 2(a)

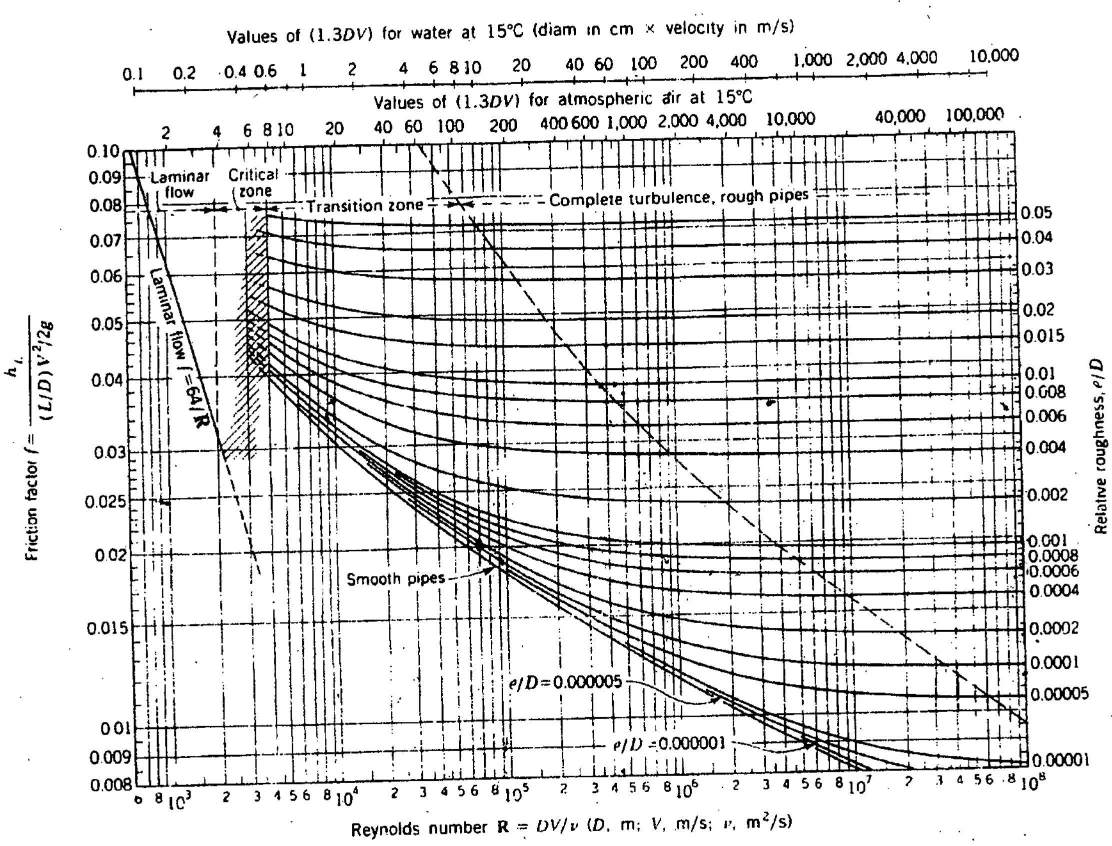

Figure Friction factor for pipes (Moody diagram).

Diagram for Q. No. 2(a)

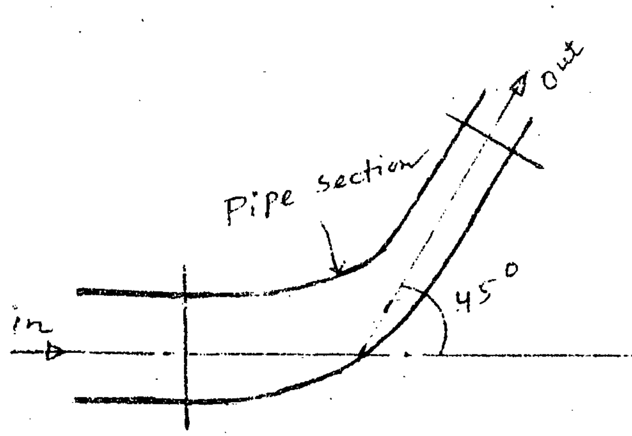

Fig. for Q. No. 3(a)

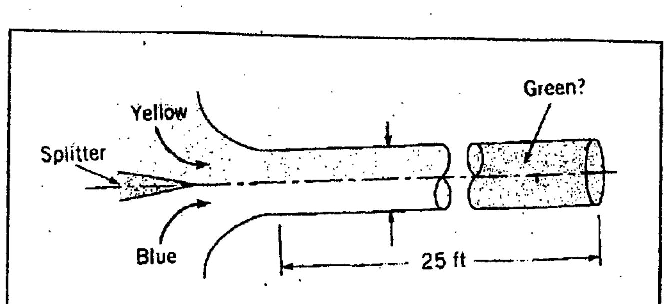

Fig. for Q. No. 4(a)

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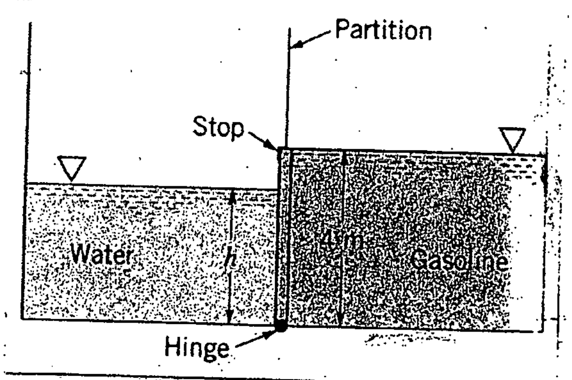

Figure for Question No. 6(a)

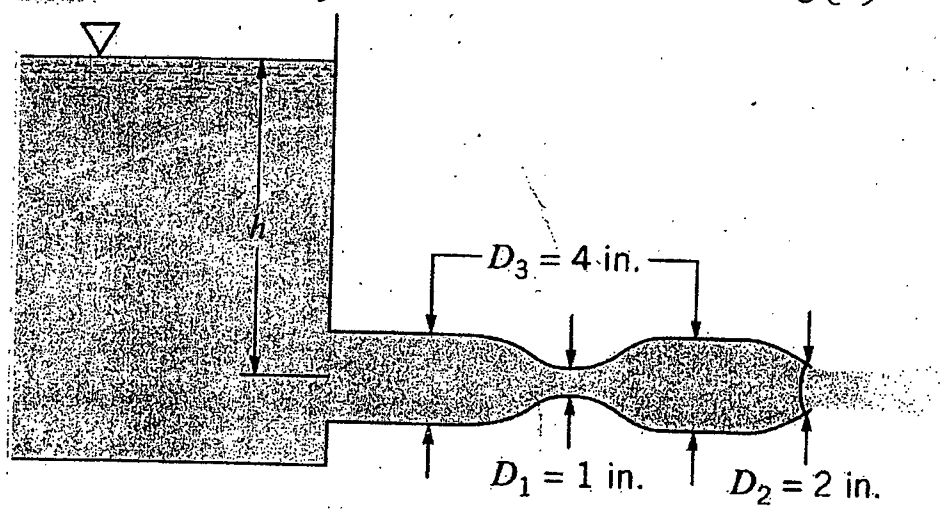

Figure for Question No. 7(a)

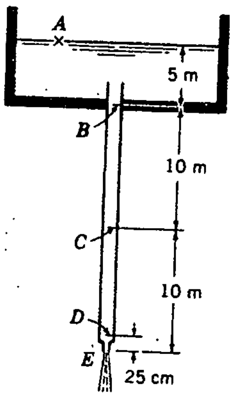

Figure for Question No. 7(b)

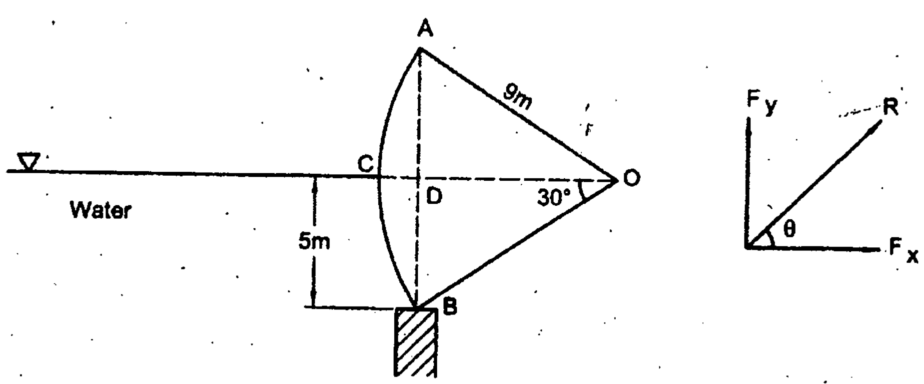

Figure for Question No. 8(c)

L-1/T-2/NAME **Date : 14/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **ME 169** (Basic Thermal Engineering)

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) Compare classical and statistical approaches of thermodynamics. **(7)**

(b) What is quality of steam? Does it have any meaning in the superheated vapor region? Can quality be expressed as the ratio of the volume occupied by the vapor phase to the total volume? Explain. **(3+2+5=10)**

(c) What is thermodynamic property? Differentiate intensive and extensive property. Separate the list of the following properties into extensive properties, intensive properties and non properties. **(3+5+12=18)**

Name of the property	Symbol	Name of the property	Symbol
Pressure	P	Acceleration	a
Force	F	Mass	m
Volume	V	Length	L
Specific Volume	v	Time	t
Density	ρ	Specific enthalpy	h
Temperature	T	Velocity	$\vec{V}$

2. (a) Write down the steady state steady flow (SSSF) equation and simplify the equation for the following devices: **(15)**

(i) Nozzles and diffusers

(ii) Turbines and compressures

(iii) Throttling process.

(b) Consider the steam power plant as shown in fig. 2(b). The following data are for such a power plant. With proper assumptions determine the following quantities per kilogram flowing through the unit: **(20)**

(i) Heat transfer in the line between the boiler and turbine.

(ii) Turbine work

(iii) Heat transfer in the condenser

(iv) Heat transfer in the boiler.

Location	Pressure	Temperature or Quality
Leaving boiler	2.0 MPa	300°C
Entering turbine	1.9 MPa	290°C
Leaving turbine, entering condenser	15 kPa	90%
Leaving condenser, entering pump	14 kPa	45°C
Pump work = 4 kJ/kg		

3. (a) Prove that whenever a system undergoes a cycle, $\oint \frac{\partial Q}{T}$ is zero if the cycle, is reversible and negative if irreversible. **(15)**

(b) In a steam power plant 1 MW is added in the boiler, 0.58 MW is taken out in the condenser, and the pump work is 0.02 MW. Find the plants thermal efficiency. If everything could be reversed, find the COP as a refrigerator. **(10)**

(c) Let the steam power plant in problem 3(b) have 700°C in the boiler and 40°C during the heat rejection in the condenser. Does that satisfy the inequality of Clausius? Repeat the question for the cycle operated in reverse as a refrigerator. **(10)**

4. (a) Compare ideal Rankine cycle with Carnot cycle. **(8)**

(b) Write a short note on binary vapor power cycle. **(7)**

(c) Steam is the working fluid in an ideal Rankine cycle. Saturated vapor enters the turbine at 8.0 MPa and saturated liquid exits the condenser at a pressure of 0.008 MPa. The turbine and the pump have an isentropic efficiency of 85% and 70% respectively. The net power output of the cycle is 100 MW. With proper assumptions and T-s diagram, determine for the cycle. **(20)**

(i) the thermal efficiency

(ii) back work ratio

(iii) the mass flow rate of the steam, in kg/h,

(iv) the mass flow rate of the condenser cooling water, in kg/h, if cooling water enters the condenser at 15°C and exits at 35°C.

SECTION – B

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

Assume a reasonable value for any missing data.

5. (a) Describe the operating principle of a 4-stroke diesel engine. **(10)**

(b) Draw the valve timing diagrams for an average four stroke petrol engine and two stroke petrol engine. **(13)**

(c) An air-standard diesel cycle has a compression ratio of 20, and the heat transferred to the working fluid per cycle is 1800 kJ/kg. At the beginning of the compression process, the pressure is 0.1 MPa and the temperature is 28°C. Determine the thermal efficiency and maximum temperature of the cycle. **(12)**

ME 169(NAME)

6. (a) How does a Gas Turbine differ from a diesel engine? **(8)**

   (b) What are the effects of multi-stage compression and expansion in a Gas Turbine. Describe with sketches. **(9)**

   (c) Discuss the effect of compression ratio on performance of a Gas Turbine. **(9)**

   (d) What do you man by 'irreversibility' in a gas turbine? Describe with T-s diagram. **(9)**

7. (a) Explain the difference between a fire tube and a water tube boiler. State which type of boiler is used for power generation and Why? **(10)**

   (b) Sketch and describe a cochran vertical boiler. What are its special features? **(15)**

   (c) Describe with sketches the working principle of Blow off cock and spring loaded safety valve. **(10)**

8. (a) What are the advantages of economizer, air preheater and steam super heater? By a line diagram, indicate the position of theses accessories in a typical boiler plant. **(17)**

   (b) Write short notes on: **(18)**

      (i) Boiler horse power

      (ii) Knocking in I.C. Engine

      (iii) Combined cycle power plant

      (iv) Regenerative Gas Turbine.

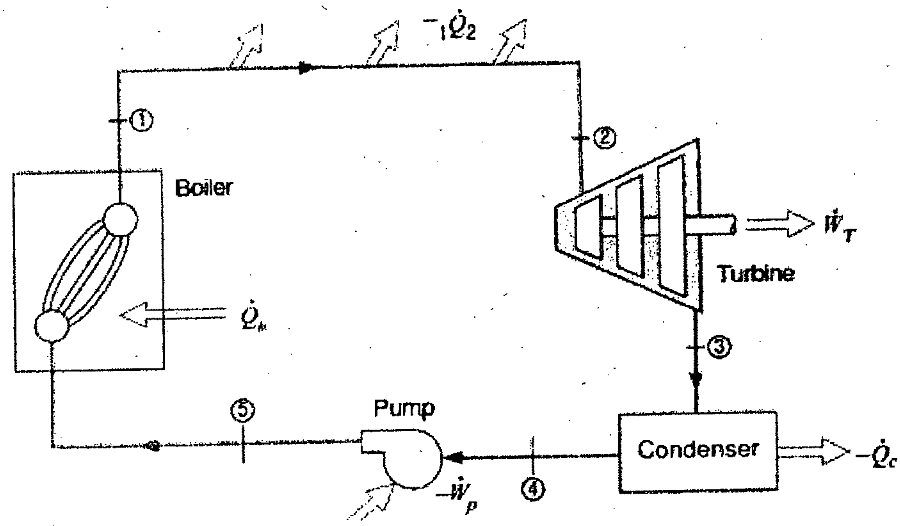

Figure for Que. No. 2(b)

Thermodynamic properties of water

Saturated Water Pressure Entry

Press. (kPa)	Temp. (°C)	Specific Volume, m³/kg Sat. Liquid v_f	Evap. v_{fg}	Sat. Vapor v_g	Internal Energy, kJ/kg Sat. Liquid u_f	Evap. u_{fg}	Sat. Vapor u_g
0.6113	0.01	0.001000	206.131	206.132	0	2375.3	2375.3
1	6.98	0.001000	129.20702	129.20802	29.29	2355.69	2384.98
1.5	13.03	0.001001	87.97913	87.98013	54.70	2338.63	2393.32
2	17.50	0.001001	67.00285	67.00385	73.47	2326.02	2399.48
2.5	21.08	0.001002	54.25285	54.25385	88.47	2315.93	2404.40
3	24.08	0.001003	45.66402	45.66502	101.03	2307.48	2408.51
4	28.96	0.001004	34.79915	34.80015	121.44	2293.73	2415.17
5	32.88	0.001005	28.19150	28.19251	137.79	2282.70	2420.49
7.5	40.29	0.001008	19.23674	19.23775	168.76	2261.74	2430.50
10	45.81	0.001010	14.67254	14.67355	191.79	2246.10	2437.89
15	53.97	0.001014	10.02117	10.02218	225.90	2222.83	2448.73
20	60.06	0.001017	7.64835	7.64937	251.36	2205.36	2456.71
25	64.97	0.001020	6.20322	6.20424	271.88	2191.21	2463.08
30	69.10	0.001022	5.22816	5.22918	289.18	2179.22	2468.40
40	75.87	0.001026	3.99243	3.99345	317.51	2159.49	2477.00

Saturated Water Pressure Entry

Press. (kPa)	Temp. (°C)	Enthalpy, kJ/kg Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Entropy, kJ/kg-K Sat. Liquid s_f	Evap. s_{fg}	Sat. Vapor s_g
0.6113	0.01	0.00	2501.3	2501.3	0	9.1562	9.1562
1.0	6.98	29.29	2484.89	2514.18	0.1059	8.8697	8.9756
1.5	13.03	54.70	2470.59	2525.30	0.1956	8.6322	8.8278
2.0	17.50	73.47	2460.02	2533.49	0.2607	8.4629	8.7236
2.5	21.08	88.47	2451.56	2540.03	0.3120	8.3311	8.6431
3.0	24.08	101.03	2444.47	2545.50	0.3545	8.2231	8.5775
4.0	28.96	121.44	2432.93	2554.37	0.4226	8.0520	8.4746
5.0	32.88	137.79	2423.66	2561.45	0.4763	7.9187	8.3950
7.5	40.29	168.77	2406.02	2574.79	0.5763	7.6751	8.2514
10	45.81	191.81	2392.82	2584.63	0.6492	7.5010	8.1501
15	53.97	225.91	2373.14	2599.06	0.7548	7.2536	8.0084
20	60.06	251.38	2358.33	2609.70	0.8319	7.0766	7.9085
25	64.97	271.90	2346.29	2618.19	0.8930	6.9383	7.8313
30	69.10	289.21	2336.07	2625.28	0.9439	6.8247	7.7686
40	75.87	317.55	2319.19	2636.74	1.0258	6.6441	7.6700

Saturated Water Pressure Entry

Press. (kPa)	Temp. (°C)	Specific Volume, m³/kg Sat. Liquid v_f	Evap. v_{fg}	Sat. Vapor v_g	Internal Energy, kJ/kg Sat. Liquid u_f	Evap. u_{fg}	Sat. Vapor u_g
850	172.96	0.001118	0.22586	0.22698	731.25	1847.45	2578.69
900	175.38	0.001121	0.21385	0.21497	741.81	1838.65	2580.46
950	177.69	0.001124	0.20306	0.20419	751.94	1830.17	2582.11
1000	179.91	0.001127	0.19332	0.19444	761.67	1821.97	2583.64
1100	184.09	0.001133	0.17639	0.17753	780.08	1806.32	2586.40
1200	187.99	0.001139	0.16220	0.16333	797.27	1791.55	2588.82
1300	191.64	0.001144	0.15011	0.15125	813.42	1777.53	2590.95
1400	195.07	0.001149	0.13969	0.14084	828.68	1764.15	2592.83
1500	198.32	0.001154	0.13062	0.13177	843.14	1751.3	2594.5
1750	205.76	0.001166	0.11232	0.11349	876.44	1721.39	2597.83
2000	212.42	0.001177	0.09845	0.09963	906.42	1693.84	2600.26
2250	218.45	0.001187	0.08756	0.08875	933.81	1668.18	2601.98

Saturated Water Pressure Entry

Press. (kPa)	Temp. (°C)	Enthalpy, kJ/kg Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Entropy, kJ/kg-K Sat. Liquid s_f	Evap. s_{fg}	Sat. Vapor s_g
850	172.96	732.20	2039.43	2771.63	2.0709	4.5711	6.6421
900	175.38	742.82	2031.12	2773.94	2.0946	4.5280	6.6225
950	177.69	753.00	2023.08	2776.08	2.1171	4.4869	6.6040
1000	179.91	762.79	2015.29	2778.08	2.1386	4.4478	6.5864
1100	184.09	781.32	2000.36	2781.68	2.1791	4.3744	6.5535
1200	187.99	798.64	1986.19	2784.82	2.2165	4.3067	6.5233
1300	191.64	814.91	1972.67	2787.58	2.2514	4.2438	6.4953
1400	195.07	830.29	1959.72	2790.00	2.2842	4.1850	6.4692
1500	198.32	844.87	1947.28	2792.15	2.3150	4.1298	6.4448
1750	205.76	878.48	1917.95	2796.43	2.3851	4.0044	6.3895
2000	212.42	908.77	1890.74	2799.51	2.4473	3.8935	6.3408
2250	218.45	936.48	1865.19	2801.67	2.5034	3.7938	6.2971

Superheated Vapor Water

Temp. (°C)	v (m³/kg)	u (kJ/kg)	h (kJ/kg)	s (kJ/kg-K)
	1800 kPa (207.15°C)			
Sat.	0.11042	2598.38	2797.13	6.3793
250	0.12497	2686.02	2910.96	6.6066
300	0.14021	2776.83	3029.21	6.8226
350	0.15457	2862.95	3141.18	7.0099
400	0.16847	2947.66	3250.90	7.1793

Superheated Vapor Water

Temp. (°C)	v (m³/kg)	u (kJ/kg)	h (kJ/kg)	s (kJ/kg-K)
	2000 kPa (212.42°C)			
Sat.	0.09963	2600.26	2799.51	6.3408
250	0.11144	2679.58	2902.46	6.5452
300	0.12547	2772.56	3023.50	6.7663
350	0.13857	2859.81	3136.96	6.9562
400	0.15120	2945.21	3247.60	7.1270
450	0.16353	3030.41	3357.48	7.2844

Properties of Saturated Water (Liquid–Vapor): Pressure Table

Pressure Conversions:
1 bar = 0.1 MPa
= 10^2 kPa

Press. bar	Temp. °C	Specific Volume m³/kg Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Internal Energy kJ/kg Sat. Liquid u_f	Sat. Vapor u_g	Enthalpy kJ/kg Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Entropy kJ/kg · K Sat. Liquid s_f	Sat. Vapor s_g	Press. bar
0.04	28.96	1.0040	34.800	121.45	2415.2	121.46	2432.9	2554.4	0.4226	8.4746	0.04
0.06	36.16	1.0064	23.739	151.53	2425.0	151.53	2415.9	2567.4	0.5210	8.3304	0.06
0.08	41.51	1.0084	18.103	173.87	2432.2	173.88	2403.1	2577.0	0.5926	8.2287	0.08
0.10	45.81	1.0102	14.674	191.82	2437.9	191.83	2392.8	2584.7	0.6493	8.1502	0.10
0.20	60.06	1.0172	7.649	251.38	2456.7	251.40	2358.3	2609.7	0.8320	7.9085	0.20
0.30	69.10	1.0223	5.229	289.20	2468.4	289.23	2336.1	2625.3	0.9439	7.7686	0.30
0.40	75.87	1.0265	3.993	317.53	2477.0	317.58	2319.2	2636.8	1.0259	7.6700	0.40
0.50	81.33	1.0300	3.240	340.44	2483.9	340.49	2305.4	2645.9	1.0910	7.5939	0.50
0.60	85.94	1.0331	2.732	359.79	2489.6	359.86	2293.6	2653.5	1.1453	7.5320	0.60
0.70	89.95	1.0360	2.365	376.63	2494.5	376.70	2283.3	2660.0	1.1919	7.4797	0.70
0.80	93.50	1.0380	2.087	391.58	2498.8	391.66	2274.1	2665.8	1.2329	7.4346	0.80
0.90	96.71	1.0410	1.869	405.06	2502.6	405.15	2265.7	2670.9	1.2695	7.3949	0.90
1.00	99.63	1.0432	1.694	417.36	2506.1	417.46	2258.0	2675.5	1.3026	7.3594	1.00
1.50	111.4	1.0528	1.159	466.94	2519.7	467.11	2226.5	2693.6	1.4336	7.2233	1.50
2.00	120.2	1.0605	0.8857	504.49	2529.5	504.70	2201.9	2706.7	1.5301	7.1271	2.00
2.50	127.4	1.0672	0.7187	535.10	2537.2	535.37	2181.5	2716.9	1.6072	7.0527	2.50
3.00	133.6	1.0732	0.6058	561.15	2543.6	561.47	2163.8	2725.3	1.6718	6.9919	3.00
3.50	138.9	1.0786	0.5243	583.95	2546.9	584.33	2148.1	2732.4	1.7275	6.9405	3.50
4.00	143.6	1.0836	0.4625	604.31	2553.6	604.74	2133.8	2738.6	1.7766	6.8959	4.00
4.50	147.9	1.0882	0.4140	622.25	2557.6	623.25	2120.7	2743.9	1.8207	6.8565	4.50
5.00	151.9	1.0926	0.3749	639.68	2561.2	640.23	2108.5	2748.7	1.8607	6.8212	5.00
6.00	158.9	1.1006	0.3157	669.90	2567.4	670.56	2086.3	2756.8	1.9312	6.7600	6.00
7.00	165.0	1.1080	0.2729	696.44	2572.5	697.22	2066.3	2763.5	1.9922	6.7080	7.00
8.00	170.4	1.1148	0.2404	720.22	2576.8	721.11	2048.0	2769.1	2.0462	6.6628	8.00
9.00	175.4	1.1212	0.2150	741.83	2580.5	742.83	2031.1	2773.9	2.0946	6.6226	9.00
10.0	179.9	1.1273	0.1944	761.68	2583.6	762.81	2015.3	2778.1	2.1387	6.5863	10.0
15.0	198.3	1.1539	0.1318	843.16	2594.5	844.84	1947.3	2792.2	2.3150	6.4448	15.0
20.0	212.4	1.1767	0.09963	906.44	2600.3	908.79	1890.7	2799.5	2.4474	6.3409	20.0
25.0	224.0	1.1973	0.07998	959.11	2603.1	962.11	1841.0	2803.1	2.5547	6.2575	25.0
30.0	233.9	1.2165	0.06668	1004.8	2604.1	1008.4	1795.7	2804.2	2.6457	6.1869	30.0
35.0	242.6	1.2347	0.05707	1045.4	2603.7	1049.8	1753.7	2803.4	2.7253	6.1253	35.0
40.0	250.4	1.2522	0.04978	1082.3	2602.3	1087.3	1714.1	2801.4	2.7964	6.0701	40.0
45.0	257.5	1.2692	0.04406	1116.2	2600.1	1121.9	1676.4	2798.3	2.8610	6.0199	45.0
50.0	264.0	1.2859	0.03944	1147.8	2597.1	1154.2	1640.1	2794.3	2.9202	5.9734	50.0
60.0	275.6	1.3187	0.03244	1205.4	2589.7	1213.4	1571.0	2784.3	3.0267	5.8892	60.0
70.0	285.9	1.3513	0.02737	1257.6	2580.5	1267.0	1505.1	2772.1	3.1211	5.8133	70.0
80.0	295.1	1.3842	0.02352	1305.6	2569.8	1316.6	1441.3	2758.0	3.2068	5.7432	80.0
90.0	303.4	1.4178	0.02048	1350.5	2557.8	1363.3	1378.9	2742.1	3.2858	5.6772	90.0
100.	311.1	1.4524	0.01803	1393.0	2544.4	1407.6	1317.1	2724.7	3.3596	5.6141	100.
110.	318.2	1.4886	0.01599	1433.7	2529.8	1450.1	1255.5	2705.6	3.4295	5.5527	110.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **MATH 183** (Coordinate Geometry and Ordinary Differential Equations)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Symbols have their usual meaning.

1\. (a) Transform the equation $17x^2 + 18xy - 7y^2 - 16x - 32y - 18 = 0$ to one in which there is no term involving x, y and xy, both the sets of axes being rectangular. **(18)**

(b) If $S = ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a pair of straight lines, show that the area of the triangle formed by their bisectors and the axis of x is $\Delta = \frac{\sqrt{(a-b)^2 + 4h^2}}{2h} \bullet \frac{ca - g^2}{ab - h^2}$. **(17)**

2\. (a) The circle $x^2 + y^2 + 2x - 4y - 11 = 0$ and the line $x - y + 1 = 0$, intersect at A and B. Find the equation of the circle on AB as diameter and the equation of the circle through A, B orthogonal to the given circle. **(18)**

(b) The circle $x^2 + y^2 = a^2$ cuts off an intercept on the straight line $lx + my = 1$ which subtends an angle of 45° at the origin, show that $4\left[a^2\left(l^2 + m^2\right) - 1\right] = \left[a^2\left(l^2 + m^2\right) - 2\right]^2$. **(17)**

3\. (a) Show that tangents at the extremities of a focal chord of a parabola intersect at right angles of the directrix. **(18)**

(b) If l and l' are the lengths of segments of any focal chord of the parabola $y^2 = 4ax$. Find the value of $\frac{l + l'}{ll'}$ in terms of a. **(17)**

4\. (a) Find the equation to the hyperbola whose asymptotes are parallel to $2x + 3y = 0$ and $3x + 2y = 0$, whose centre is at (1, 2) and which passes through (5, 3). **(18)**

(b) Find a pair of conjugate semi-diameters inclined at an angle $tan^{-1} 7$ for the ellipse $8x^2 + 12y^2 = 96$. **(17)**

Contd P/2

MATH 183(NAME)

SECTION – B

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

5. (a) Find the differentiate equation of the family of curves $y = e^x(A\cos x + B\sin x)$, where A and B are arbitrary constants. **(10)**

   (b) Solve the followings: **(12+13)**

   (i) $\frac{dy}{dx} = (4x + y + 1)^2$

   (ii) $\left(x\cos\frac{y}{x} + y\sin\frac{y}{x}\right)y = \left(y\sin\frac{y}{x} - x\cos\frac{y}{x}\right)x\frac{dy}{dx}$

6. Solve the following differential equations:

   (i) $(x^2 + y^2 + x)dx + xydy = 0$. **(12)**

   (ii) $x\frac{dy}{dx} - 2y = x^2 + \sin\frac{1}{x^2}$. **(10)**

   (iii) $\frac{dy}{dx} = 1 - x(y - x) - x^2(y - x)^3$. **(13)**

7. Find the general solution of the following differential equations:

   (i) $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = e^{2x} + x^2 + x$. **(10)**

   (ii) $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 3x^2e^{2x}\sin 2x$. **(12)**

   (iii) $x^2\frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 2y = x + \sin x$. **(13)**

8. (a) Find the general solution of the differential equation:

$$(3x+2)^2\frac{d^2y}{dx^2} - 5(3x+2)\frac{dy}{dx} - 3y = x^2 + x + 1$$ **(15)**

   (b) Solve the differential equations:

   (i) $x^2\left(\frac{dy}{dx}\right)^2 + 3xy\frac{dy}{dx} + 2y^2 = 0$. Where $\frac{dy}{dx} = p$. **(10)**

   (ii) $x\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - \frac{dy}{dx} = 0$. **(10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **PHY 161** (Waves and Oscillations, Geometrical Optics and Wave Mechanics)

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** questions.

1. (a) Briefly explain two experimental observations that can not be explained in terms of classical mechanics. **(10)**

(b) Obtains an expression for the de-Broglie wavelength of matter waves. Explain briefly how wave nature of electron improved significantly the resolution of an electron microscope compared to that of an optical microscope. **(7+8)**

(c) A microscope, using photons, is employed to locate an electron in an atom to within a distance of 0.2 Å. What is the uncertainty in the momentum of the electron? **(10)**

2. (a) What is wave function? Write down the physical interpretation of wave function. **(10)**

(b) Derive the time independent form of the Schrödinger equation for a particle of mass 'm' moving in potential energy 'v'. **(15)**

(c) Write down the energy expression for a strongly bound electron. Draw schematically the allowed energy values of an electron that is bound to its atomic nucleus. **(4+6)**

3. (a) Write down to fundamental postulates of statistical mechanics. **(5)**

(b) Write down the name and expression of the three most probable distribution laws. Distinguish between Fermions and Bosons. **(6+4)**

(c) Apply Fermi-dirac distribution law to an electron gas to obtain an expression for Fermi energy in terms of density of free electrons. (20)

4. (a) Define cardinal points of a thick lens. **(10)**

(b) Two coaxial thin convergent lenses of focal lengths f_1 and f_2 are separated by a distance 'd' in air. Show that the position of the equivalent lens can be obtained from the equation.

$$\beta = -\frac{df_2}{f_1 + f_2 - d}$$

where the symbols have their usual meaning. **(15)**

(c) Two thin convex lenses of focal lengths 20 cm and 5 cm are placed 10 cm apart. Calculate the equivalent focal length and find the positions of the principle points of the combination. **(10)**

PHY 161(NAME)

SECTION – B

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

5. (a) What do you mean by coma and distribution in lens? Explain these with suitable diagrams. **(10)**

   (b) Due to spherical aberration at a single surface, show that the marginal rays meet the principal axis at points nearer the surface as compared to the paraxial rays. **(20)**

   (c) The focal lengths of a convex lens are 100 cm and 98 cm for red and blue rays, respectively. Calculate the dispersive power of the material of the lens. **(5)**

6. (a) Show that the principal points of a lens coincide with the nodal points when the optical system is situated in the same medium. **(10)**

   (b) Prove that the achromatism for two thin lenses in contact cannot be achieved by taking the two lenses of the same dispersive power. **(10)**

   (c) In case of deviation without dispersion, show that the achromatism in prisms can be obtained if $\omega\delta + \omega'\delta' = 0$, where the symbols have their usual meaning. **(10)**

   (d) For crown glass, the values of refractive index and wavelength are μ_c = 1.514 and $\lambda_c = 6563\,\mathring{A}$. For flint glass, the corresponding values are $\mu_F = 1.524$ and $\lambda_F = 4862\,\mathring{A}$. Calculate the values of Cauchy's constants for crown glass. **(5)**

7. (a) What are damped vibrations? What is the effect of damping on the natural frequency of an oscillator? **(7)**

   (b) Two oscillating bodies of mass m_1 and m_2 are connected by a spring on a horizontal frictionless surface. Show that their relative motion can be represented by the oscillation of a single body having reduced mass, μ. **(20)**

   (c) Two masses m_1 = 3 kg and m_2 = 4 kg are connected by a spring. Find the oscillation frequency of the two body system. Given that the extension of the spring is 2.5 cm for applied force of 2.5 N. **(8)**

8. (a) What are reverberation and reverberation time? On what factors does it depend? **(8)**

   (b) Show that the rate of transfer of energy of a plane progressive wave depends on the square of the amplitude and the frequency. **(20)**

   (c) A musical instrument of frequency 280 Hz is sending out waves of amplitude 10^{-3} cm. Calculates the intensity of sound. Given, the velocity of sound is 332 m/s and density of air is 1.29 kg/m^3. **(7)**

L-1/T-2/NAME Date : 04/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **EEE 161** (Electrical Engineering Principles)

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** questions.

1. (a) Explaining different kind of losses in single phase transformer derive its equivalent circuit. Draw the approximate and exact equivalent circuits of single phase transformer referred to primary and secondary sides. **(17)**

(b) A 100VA 120V/12V transformer is to be connected so as to form a step-up autotransformer. The high voltage side is to be considered common winding and the low voltage side, series winding. **(18)**

(i) If a primary voltage of 120V applied to the transformer, what is the maximum voltampere (VA) rating in this mode of operation?

(ii) What is the apparent power rating advantage of this transformer?

(iii) If a primary voltage of 110V is applied to the transformer what is the secondary voltage?

2. (a) Explain three methods to control the speed of DC shunt motor and their respective advantages and disadvantages. **(20)**

(b) Draw the equivalent circuit of DC shunt generator and explain how voltage builds up in it. **(15)**

3. (a) Find i_x in the circuit of Fig. for Q. No. 3(a). **(17)**

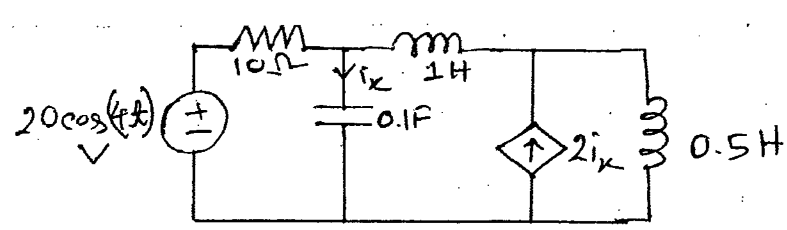

Fig. for Q. No. 3(a)

(b) Find the rms value of the following voltage wave in Fig. for Q. No. 3(b). Calculate the overage power dissipated in a 6 Ω resistor. **(18)**

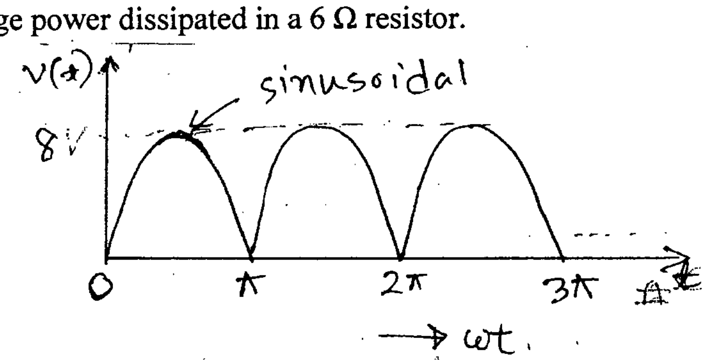

Fig. for Q. No. 3(b)

Contd P/2

EEE 161(NAME)

4. (a) The voltage across a load is v(t) = 60 cos(ωt − 10°) V and the current through this element is i(t) = 1.5 cos(ωt + 50°)A. Find **(18)**

   (i) the complex and apparent powers.

   (ii) the real and reactive powers.

   (iii) the power factor and the load impedance, and

   (iv) the parallel inductor needed to make the power factor unity.

   (b) Find all the line voltages, line currents, and phase currents in the circuit of Fig. for Q. No. 4(b). Mention the phase sequence of this circuit (all impedances are in Ω). **(17)**

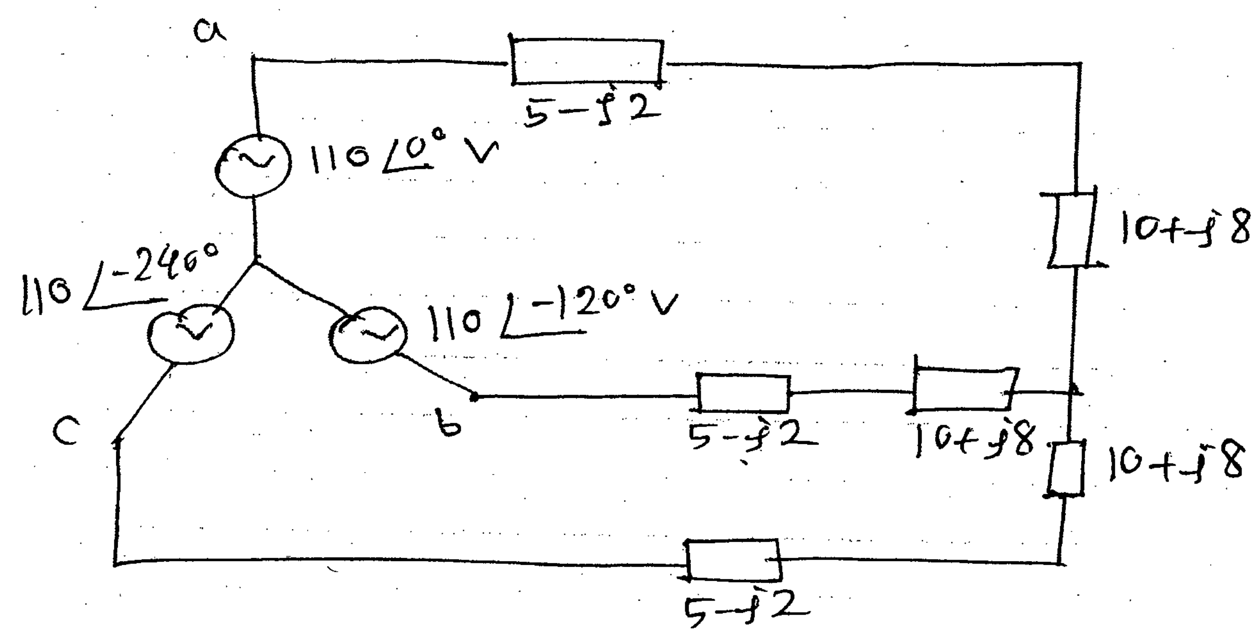

Fig. for Q. No. 4(b)

SECTION – B

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

5. (a) For the circuit in Fig. for Q. No. 5(a), $V_x = V_a - Vb$. Find out the voltages of node 'a' and 'b'. **(18)**

   (b) For the circuit shown in Fig. for Q. No. 5(b), calculate the equivalent resistance between node 'a' and 'b'. **(17)**

6. (a) For the circuit shown in Fig. for Q. No. 6(a), Find the value of V_o using source transformation. **(17)**

   (b) For the circuit shown in Fig. for Q. No. 6(b), Find the value of I_1 using superposition theorem. **(18)**

EEE 161(NAME)

7. (a) Consider the circuit of Fig. for Q. No. 7(a). Find the value of R_L for maximum power transfer. Also, calculate the power absorbed by R_L and the current through R_L. **(18)**

   (b) For the circuit shown in Fig. for Q. No. 7(b), Find out the value of V_L. **(17)**

8. (a) For the circuit shown in Fig. for Q. No. 8(a), Draw the Thevenin equivalent circuit and Norton equivalent circuit seen at terminals a - b. **(18)**

   (b) Calculate V_o in the circuit shown in Fig. for Q. No. 8(b). **(17)**

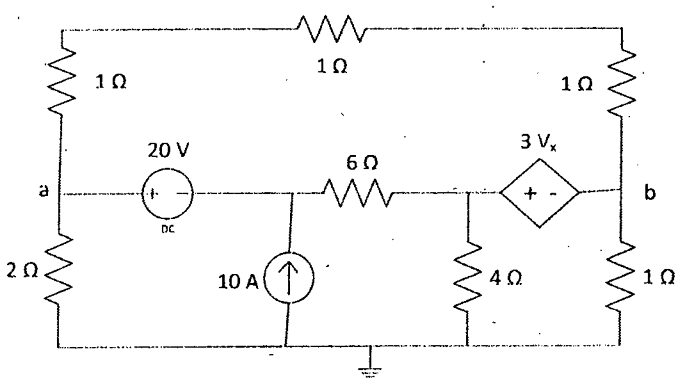

Fig. for Q. No. 5 (a)

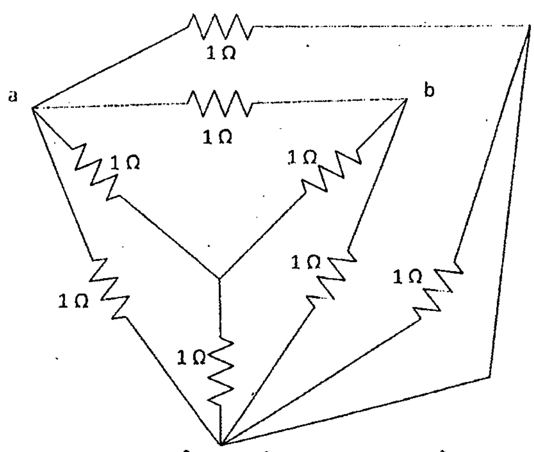

Fig. for Q. No. 5 (b)

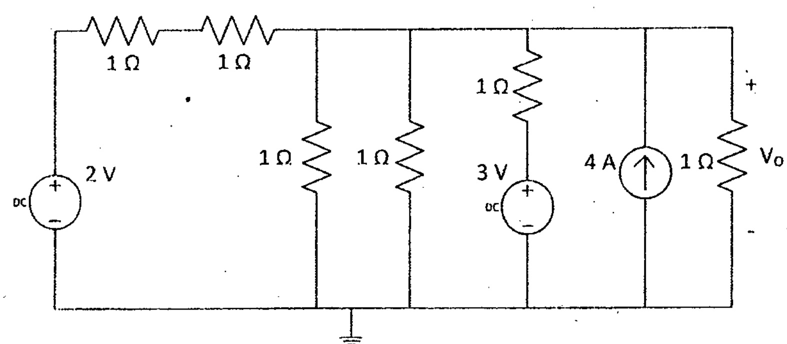

Fig. for Q. No. 6 (a)

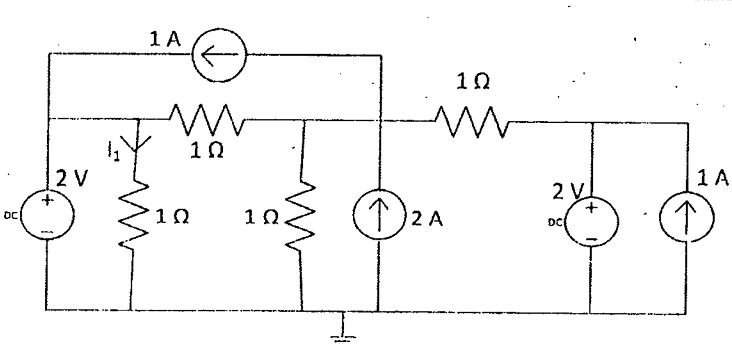

Fig. for Q. No. 6 (b)

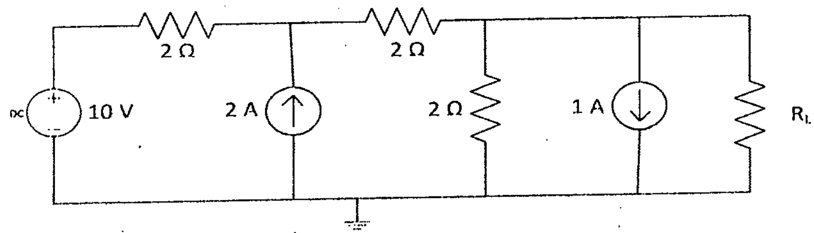

Fig. for Q. NO. 7(a)

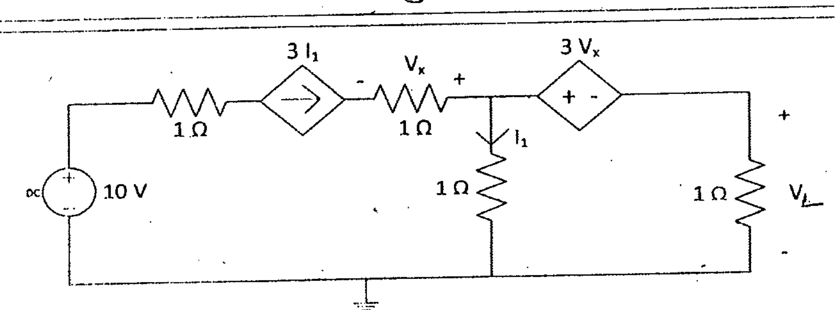

Fig. for. Q. No. 7(b)

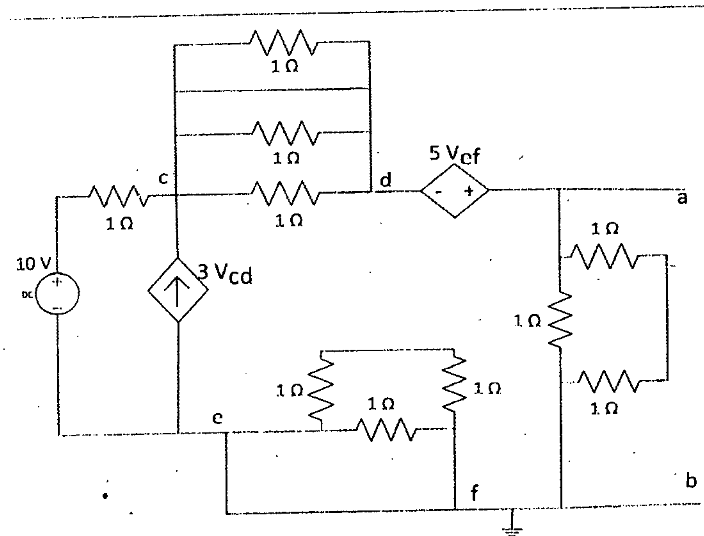

Fig. for. Q. NO. 8(a)

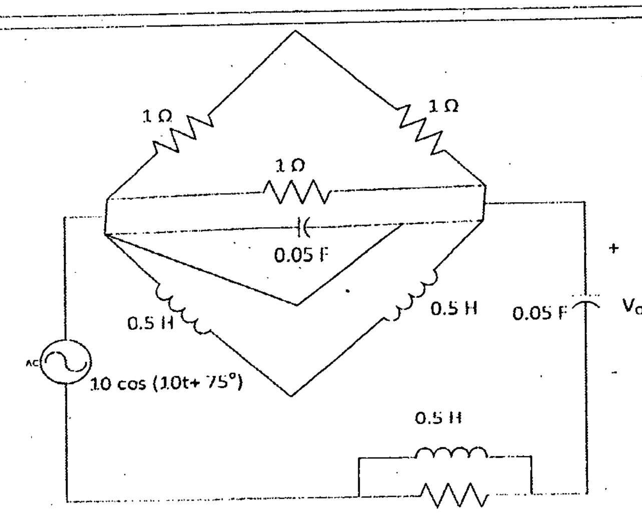

Fig. for Q. No 8(b)