BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Transfer the equation $11x^2 - 4xy + 14y^2 - 58x - 44y + 126 = 0$ to the new axes of X and Y whose equations are $x - 2y + 1 = 0$ and $2x + y - 8 = 0$ respectively. **(18)**

   (b) Prove that two of the lines represented by equation $ax^4 + bx^3y + cx^2y^2 + dxy^3 + ay^4 = 0$ will bisect angle between the other two if $c + 6a = 0, b + d = 0$. **(17)**

2. (a) If the equation $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents two straight lines then prove that the square of the distance of their point of intersection from the origin is $\frac{c(a+b) - f^2 - g^2}{ab - h^2}$. **(18)**

   (b) Find the condition that the intercept made by the circle $x^2 + y^2 = a^2$ on the line $x\cos\alpha + y\sin\alpha = p$ subtends a right angle at the point (h, k). **(17)**

3. (a) Find the equation of the circle whose diameter is the common chord of the circle $x^2 + y^2 + 2x + 3y + 1 = 0$ and $x^2 + y^2 + 4x + 3y + 2 = 0$. **(17)**

   (b) Prove that the locus of the middle points of the portions of the tangents to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ included between the axes is the curve $\frac{a^2}{x^2} + \frac{b^2}{y^2} = 4$. **(18)**

4. (a) Find the locus of the point of intersection of two normals to the parabola $y^2 = 4ax$ which are at right angles to one another. **(18)**

   (b) Find the asymptotes of the hyperbola $6x^2 - 7xy - 3y^2 - 2x - 8y - 6 = 0$. Also find the equation of the conjugate hyperbola. **(17)**

Contd P/2

MATH 183

SECTION – B

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

5. Solve the following differential equations:

 (a) $(x+y+1)\dfrac{dy}{dx}=1$ **(11)**

 (b) $\left(x\cos\dfrac{y}{x}+y\sin\dfrac{y}{x}\right)y-\left(y\sin\dfrac{y}{x}-x\cos\dfrac{y}{x}\right)x\dfrac{dy}{dx}=0$ **(12)**

 (c) $\dfrac{dy}{dx}=\dfrac{2x-y+1}{x+2y-3}$ **(12)**

6. (a) Find the integrating factor and hence solve: $(xy^2+2x^2y^3)dx+(x^2y-x^3y^2)dy=0$ **(13)**

 (b) Solve: $(1-x^2)\dfrac{dy}{dx}+xy=xy^2$ **(11)**

 ((c) Solve $\dfrac{d^2x}{dt^2}+4\dfrac{dx}{dt}+3x=0$, given that, for $t=0$, $x=0$ and $\dfrac{dx}{dt}=12$ **(11)**

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

 (a) $\dfrac{d^3y}{dx^3}+y=\cos 2x$ **(11)**

 (b) $\dfrac{d^2y}{dx^2}-4\dfrac{dy}{dx}+4y=e^{2x}\cos^2 x$ **(11)**

 (c) $\dfrac{d^2y}{dx^2}+3\dfrac{dy}{dx}+2y=xe^x\sin x$ **(13)**

8. Solve the following:

 (a) $y=2px-p^2$, where $p\equiv\dfrac{dy}{dx}$ **(10)**

 (b) $x\dfrac{d^2y}{dx^2}+(1-x)\dfrac{dy}{dx}-y=e^x$ by the method based on the factorization of the operator. **(13)**

 (c) $(1-x^2)\dfrac{d^2y}{dx^2}-x\dfrac{dy}{dx}=2$ **(12)**

L-1/T-2/NAME **Date : 24/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value if needed. Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Derive an expression for finding actual flow rate of fluid through a venturimeter. Show that if the pressure is measured using a Manometer, then the inclination of the water is not relevant. **(15)**

   (b) Referring to the Figure for Q. No. 1(b), assume that liquid flows from A to C at the rate of 200 L/S and that the friction loss between A and B is negligible but that between B and C it is $0.1\frac{V_B^2}{2g}$. Find the pressure heads at A and C. **(15)**

   (c) Explain what do you mean by momentum correction factor. **(5)**

2. (a) The dredger in Figure for Q. No. 2(a) is loading sand (SG = 2.6) onto a barge. The sand leaves the dredger pipe at 1.25 m/s with a weight flux 210 kg/s. Estimate the tension on the mooring line caused by this loading process. **(18)**

   (b) Explain Reynold's experiment to distinguish between laminar and turbulent flow with a sketch. Also define critical Reynolds number. **(10)**

   (c) State Bernoulli's equation and mention its limitations. **(7)**

3. (a) Two reservoirs are connected by 800 m long commercial pipe of 300 mm diameter. In the pipeline, there are four standard elbows (k = 0.9) and a globe value (k = 10). If the flow rate of water is 0.30 m^3/s, find the difference of water levels between the two reservoirs. Take kinematic viscosity of water $\nu = 1.02 \times 10^{-6}\ m^2/s$ and $\varepsilon = 0.000046$ m for commercial steel pipe. **(20)**

   (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 will it take for the level difference to half. **(15)**

Contd P/2

NAME 123

4. (a) Write short notes on: **(15)**

   (i) Cavitation

   (ii) Karman Vortex Street

   (iii) Boundary layer thickness

   (b) Water is flowing through a reducer as shown in Figure for Q. No. 4(b). If the deflection in the mercury manometer is 10 mm, find the flow rate of water. **(10)**

   (c) Water is flowing at the rate of 300 e/s through a 90° v-notch. Find the position of the apex of the notch from the bed of the channel, if the depth of water in the channel is 1.5 m. Take $C_d = 0.61$. **(10)**

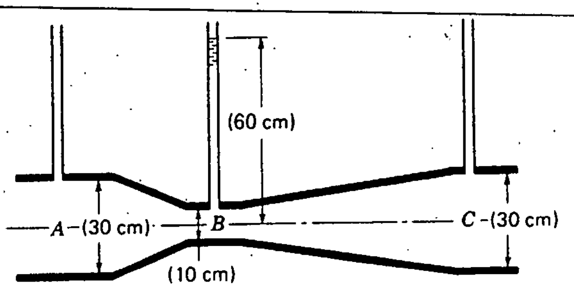


Figure for Q. No. 1 (b)

SECTION – B

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

5. (a) In the Figure, oil of viscosity μ fills the small gap of thickness Y. Determine an expression for the torque T required to rotate the truncated core at constant speed ω. Neglect fluid stress exerted on the circular bottom. What is the rate of heat generation in Joules/second if the oil's absolute viscosity is 0.20 N.s/m^2, α = 45°, a = 45 mm, b = 60 mm, Y = 0.2 mm and the speed of rotation is 90 r.p.m. **(20)**

   (b) What are the Newtonian and Non-Newtonian fluids? Explain with the help of shear stress vs. rate of shear strain diagram. **(15)**

6. (a) Water flow at a rate of 0.5 m^3/s rising through a 50° contracting pipe bend. The diameter at the bend entrance is 700 mm and at the exit 500 mm as shown in Figure for Q. No. 6(a). If the pressure at the entrance to the bend is 200 kN/m^2, determine the magnitude and direction of the force exerted by the fluid on the bend. The exit of the bend is 0.4 m higher than the entrance and the bend has a volume of 0.2m^3. **(20)**

   (b) Freshwater and Seawater flowing in parallel horizontal pipelines are connected to each other by a double U-tube manometer as shown in Figure for Q. No. 6(b). Determine the pressure difference between the two pipelines. Can the air column be ignored in the analysis? **(15)**

Contd ……….. P/3

NAME 123

7. (a) Find the magnitude and direction of the resultant force acting on the cylindrical gate of 8 m diameter and 6 m long as shown in Figure for Q. No. 7(a). **(15)**

   (b) 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

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

8. (a) Show that the resistance R to the motion of a missile depends on the length L, velocity V, air density ρ, air viscosity μ and the bulk modulus of elasticity of air β. Using Buckingham π-theorem, show that the relationship between resistance R and the variables is given by: **(20)**

$$R = \rho L^2 V^2 \varphi\left(\frac{\mu}{\rho L V}, \frac{\beta}{\rho V^2}\right)$$

   (b) A block of wood having specific gravity of 0.80 floods in water. Find the metacentric height if the size of the block is 1.2 m × 0.6 m × 0.5 m. **(15)**

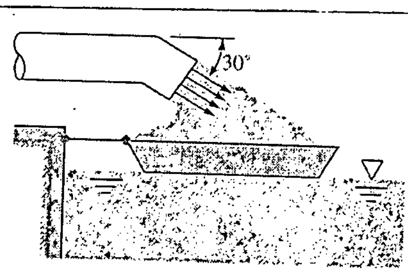


Figure for Q. No. 2(a)

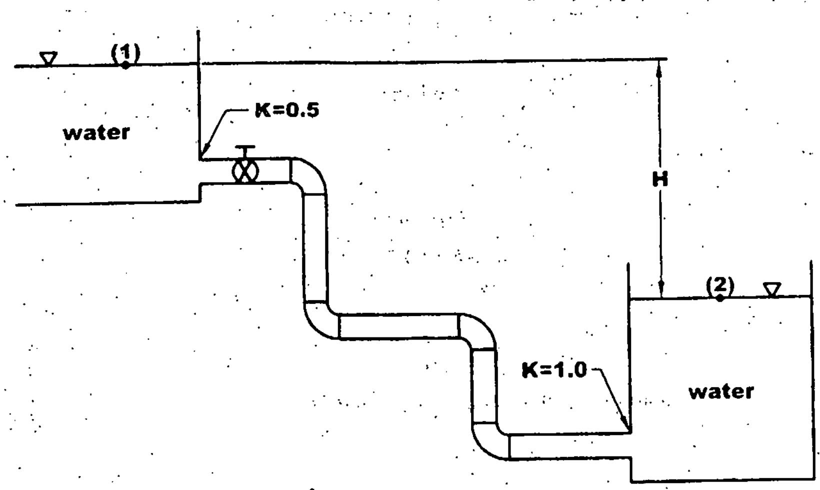
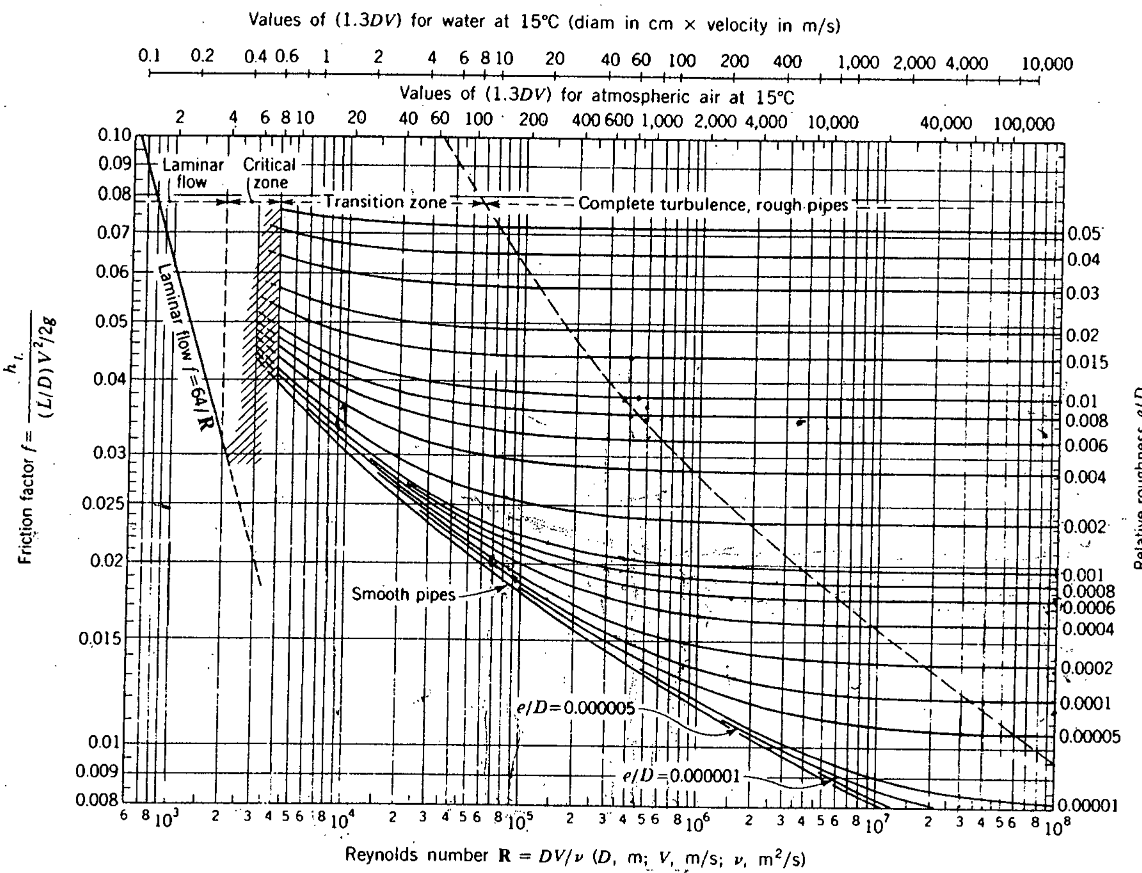


Figure for Q. No. 3(a)

NAME 123



Moody's Diagram for Q. No. 3(a)

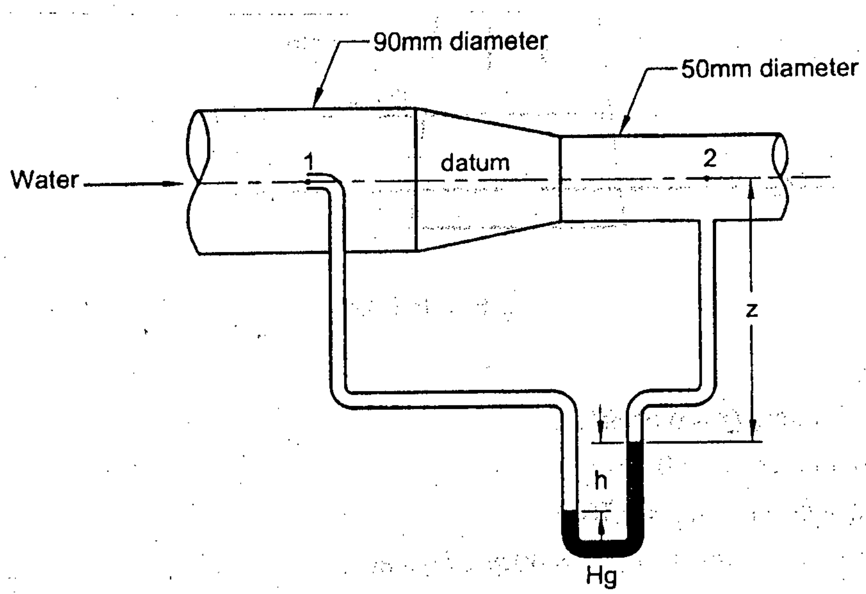


Figure for Q. No. 4(b)

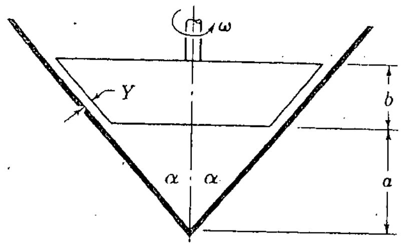


Figure for Q. No. 5(a)

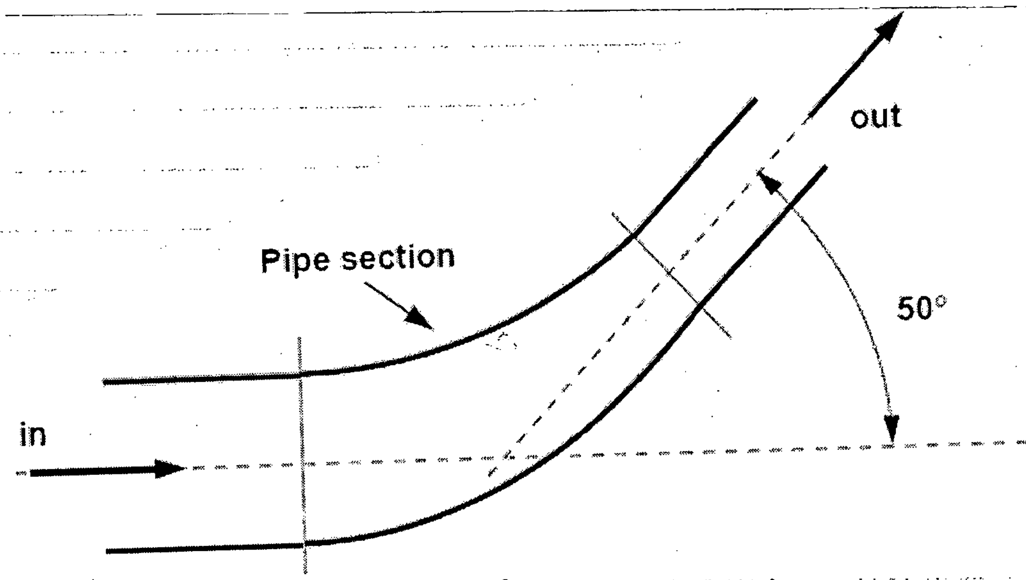


Figure for Q. No. 6(a)

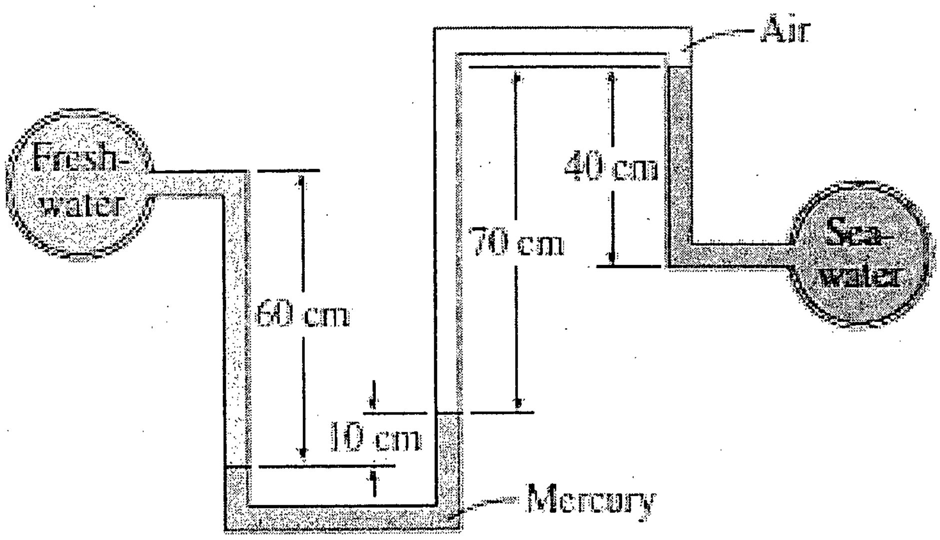


Figure for Q. No. 6(b)

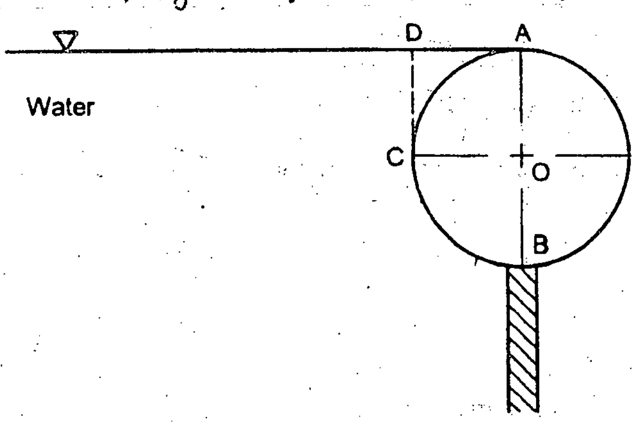


Figure for Q. No. 7(a)

L-1/T-2/NAME **Date : 28/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **PHY 161** (Waves and Oscillation, 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**.

1. (a) Write down the fundamental postulates of wave mechanics. **(10)**

(b) A particle of mass is confined in a one-dimensional box. Find the allowed energies and wave functions for such a particle. Draw schematically the wave function (ψ) and probability function ($\psi^*\psi$). **(20)**

(c) Discuss the significance of an wave function. **(5)**

2. (a) What do you understand by the terms "eigen function" and "eigen value"? **(5)**

(b) Describe an experiment which supports the particle aspects of radiation. Discuss the significance of the results so obtained. **(20)**

(c) An eigen function of the operator $\frac{d^2}{dx^2}$ is sin(nx), where n = 1, 2, 3, ... etc. Find the corresponding eigen values. **(10)**

3. (a) Make composition among three statistical distribution functions. **(10)**

(b) Derive an expression for the molecular energy distribution in an ideal gas and show that the average molecular energy of an ideal gas molecule is, $\bar{\varepsilon} = \frac{3}{2}KT$ where the symbols have their usual meaning. **(20)**

(c) Find the rms speed of oxygen molecules at 0°C. **(5)**

4. (a) What do you mean by the terms aberrations: Coma and distortion in lens? Discuss with suitable diagrams. **(9)**

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

(c) A thin converging and a thin diverging lenses are placed coaxially 5 cm apart. If the magnitude of focal lengths of each lens is 10 cm, calculate the equivalent focal length (f) and the position of principal points. **(6)**

Contd P/2

SECTION – B

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

5. (a) What do you mean by cardinal points of a thick lens? Briefly mention some ways by which the spherical aberration in lens can be minimized. **(4+6=10)**

(b) Show that the equivalent power of the combination of two thin coaxial lenses separated by a finite distance d can be expressed by the equation: $P = P_1 + P_2 - d\,P_1P_2$, where the symbols have their usual meaning. Obtain an expression for the position (β) of equivalent lens. **(12+6=18)**

(c) Calculate the value of Caucly's constant (A) for crown glass. For crown glass, μ_C = 1.54 and λ_C = 6563 Å. For flint glass, μ_F = 1.524 and λ_F = 4862 Å. **(7)**

6. (a) What should be the least possible distance between an object and its real image in a biconvex lens? Explain mathematically. **(10)**

(b) Show that achromatism cannot be achieved by taking two lenses (in contact) of same dispersive power. Mention the condition for achrometism in prisms (in case of deviation without dispersion) in terms of dispersive power and angle of deviation. **(15+3=18)**

(c) The dispersive power for crown and flint glasses are in the ratio of 1 : 2. Calculate the focal lengths of the lenses mode of crown and flint glasses which form an achromatic combination of focal length 20 cm when placed in contact. **(07)**

7. (a) Define damped oscillation and write down the different equation of it. Show that the amplitude of a damped oscillator decays with time exponentially. What happens when the damping coefficient is largess compared to the angular frequency of the oscillator? **(7+15+5=27)**

(b) An object of mass 0.2 kg is hung from a spring whose spring constant k = 80 N/m. The object is subjected to a resistive force and the damped angular frequency is $\sqrt{3}/2$ of the undamped angular frequency. What is the value of the damped coefficient? After what time the amplitude becomes e^{-1} of its initial amplitude? **(8)**

8. (a) Show that the linear combination of two simple harmonic oscillations of equal time periods is also harmonic and deduce an expression for the resultant amplitude. **(15)**

(b) Derive an expression for time period of spring mass system where the mass of the spring is not neglected. What is effective mass? **(15)**

(c) "Body mass measurement device" (BMMD) is a spring mounted chair. An astronaut measures his period of oscillation in the chair. If M be the mass of the astronaut and m the effective mass of that part of the BMMD that also oscillates, Show that $M = \left(\frac{k}{4\pi^2}\right)T^2 - m$, where T represents time period and k represents force constant. **(5)**

L-1/T-2/NAME **Date : 02/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

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) Give the comparison between Petrol and Diesel engines. **(7)**

(b) What do you understand by "air-standard cycles"? Derive the expression for efficiency of an air-standard diesel cycle in terms of compression ratio and cut-off ratio. **(10)**

(c) The compression ratio in an air-standard Otto cycle is 10. At the beginning of the compression stroke, the pressure is 0.1 MPa and the temperature is 15°C. The heat transfer to the air per cycle is 1800 kJ/kg. air. Determine- **(18)**

(i) The pressure and temperature at the end of each process of the cycle.

(ii) The thermal efficiency.

(iii) The mean effective pressure.

2. (a) Consider a regenerative vapor power cycle with one open feed water heater. Steam enters the turbine at 8.0 MPa, 480°C and expands to 0.7 MPa, where some of the steam is extracted and diverted to the open feedwater heater operating at 0.7 MPa. The remaining steam expands through the second stage turbine to the condenser pressure of 0.008 MPa. Saturated liquid exits the open feedwater heater to 0.7 MPa. The isentropic efficiency of each turbine stage is 85% and each pump operates isentropically. If the power output of the cycle is 100 MW. Determine- **(27)**

(i) Thermal efficiency of the cycle. (ii) The mass flow rate through the boiler.

(b) Write short note on – **(8)**

(i) Binary vapor power cycle. (ii) Cogeneration.

3. (a) Give the classification of boilers by mentioning the bases. **(5)**

(b) Differentiate between fire tube and water tube boilers. **(6)**

(c) Write the salient features of the following boilers with neat sketches- **(16)**

- Cochran
- Lancashire
- Locomotive
- Stirling bent tube boiler.

(d) Mentioin the use of air-preheater, super-heater, fusible plug and safety valve for a boiler. **(8)**

Contd P/2

ME 169

4. (a) What are the effects of multi-stage compression and expansion in a Gas turbine? Describe with corresponding schematic and T-s diagram. **(12)**

(b) What do you understand by "irreversibility" in a gas turbine? Describe with T-s diagram. **(8)**

(c) Mention the advantages and disadvantages of using Gas turbines. **(6)**

(d) What is a combined cycle power plant (CCPP)? Describe briefly using schematic diagram. **(9)**

SECTION – B

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

5. (a) Prove that heat and work are not properties, although their difference during a change of state in a closed system is a property. **(12)**

(b) Deduce the relation $C_p - C_v = R$ for an ideal gas where C_p and C_v are the specific heats and R is the gas constant. **(10)**

(c) An insulated rigid tank initially contains 0.6 kg of air at 30°C and 10 kPa. A paddle wheel with a power rating of 0.02 kW is operated within the tank for half an hour. Determine the final pressure and temperature, and the increase in internal energy of the air inside the tank. **(13)**

6 (a) Derive the energy equation for steady flow process. **(14)**

(b) Apply this energy equation to show that throttling is an isenthalpy process. **(7)**

(c) Air flows steadily through a compressor at the rate of 0.5 kg/s. The air enters in the compressor at 7 m/s and 0.1 MPa with a volume of 0.95 m3/kg, and leaves at 5 m/s and 0.7 MPa with a volume of 0.19 m^3/kg. The increase in internal energy between entering and leaving air is 90 kJ/kg. Cooling water in the compressor jacket absorbs heat from the compressed air at the rate of 58 kW. Calculate the rate of shaft work in kW. **(14)**

7. (a) Prove the Clausius inequality $\oint \frac{\delta Q}{T} \leq 0$. **(17)**

(b) What are the statements of the Carnot principles? **(6)**

(c) A refrigerator maintains its inside at – 10°C when the air surrounding the refrigerator is at 30°C. The refrigerant absorbs heat from the inside space of the refrigerator at 9000 kJ/h and power required to operate the refrigerator is 2000 kJ/h. Determine the coefficient of performance of the refrigerator and compare the COP of a reversible refrigeration cycle operating between the two reservoirs at the same temperatures. **(12)**

Contd P/3

8. (a) Describe the Kelvin-Planck statement and show that no heat engine can have 100 percent thermal efficiency. **(13)**

   (b) A rigid vessel contains 10 kg of water at 80°C. If 8 kg of the water is in liquid state and the rest in vapor state, determine (i) the pressure in the vessel, (ii) the volume of the vessel, and (iii) the difference in specific entropy of the two states of water and give reason for this difference. **(22)**

SATURATED STEAM - TEMPERATURE TABLE

T °C	P bar	Spec. vol. m³=kg Sat. liq. v_f X1000	Sat. vap. v_g	Int. Ener. kJ/kg Sat. liq. u_f	Sat. vap. u_g	Enthalpy kJ/kg Sat. liq. h_f	Sat. vap. h_g	Entropy kJ=(kg°K) Sat. liq. s_f	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	1.0007	99.86	46.19	2391	46.19	2522	0.1658	8.876
12	0.0140	1.0007	93.79	50.40	2392	50.4	2523	0.1806	8.852
13	0.0150	1.0007	88.13	54.59	2393	54.59	2525	0.1953	8.828
14	0.0160	1.0007	82.85	58.80	2394	58.8	2527	0.2099	8.805
15	0.0170	1.0007	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 water—Pressure table

Press., P kPa	Sat. temp., T_{sat} °C	Specific volume, m³/kg Sat. liquid, v_f	Sat. vapor, v_g	Internal energy, kJ/kg Sat. liquid, u_f	Evap., u_{fg}	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	Evap., s_{fg}	Sat. vapor, s_g
1.0	6.97	0.001000	129.19	29.302	2355.2	2384.5	29.303	2484.4	2513.7	0.1059	8.8690	8.9749
1.5	13.02	0.001001	87.964	54.686	2338.1	2392.8	54.688	2470.1	2524.7	0.1956	8.6314	8.8270
2.0	17.50	0.001001	66.990	73.431	2325.5	2398.9	73.433	2459.5	2532.9	0.2606	8.4621	8.7227
2.5	21.08	0.001002	54.242	88.422	2315.4	2403.8	88.424	2451.0	2539.4	0.3118	8.3302	8.6421
3.0	24.08	0.001003	45.654	100.98	2306.9	2407.9	100.98	2443.9	2544.8	0.3543	8.2222	8.5765
4.0	28.96	0.001004	34.791	121.39	2293.1	2414.5	121.39	2432.3	2553.7	0.4224	8.0510	8.4734
5.0	32.87	0.001005	28.185	137.75	2282.1	2419.8	137.75	2423.0	2560.7	0.4762	7.9176	8.3938
7.5	40.29	0.001008	19.233	168.74	2261.1	2429.8	168.75	2405.3	2574.0	0.5763	7.6738	8.2501
10	45.81	0.001010	14.670	191.79	2245.4	2437.2	191.81	2392.1	2583.9	0.6492	7.4996	8.1488
15	53.97	0.001014	10.020	225.93	2222.1	2448.0	225.94	2372.3	2598.3	0.7549	7.2522	8.0071
20	60.06	0.001017	7.6481	251.40	2204.6	2456.0	251.42	2357.5	2608.9	0.8320	7.0752	7.9073
25	64.96	0.001020	6.2034	271.93	2190.4	2462.4	271.96	2345.5	2617.5	0.8932	6.9370	7.8302
30	69.09	0.001022	5.2287	289.24	2178.5	2467.7	289.27	2335.3	2624.6	0.9441	6.8234	7.7675
40	75.86	0.001026	3.9933	317.58	2158.8	2476.3	317.62	2318.4	2636.1	1.0261	6.6430	7.6691
50	81.32	0.001030	3.2403	340.49	2142.7	2483.2	340.54	2304.7	2645.2	1.0912	6.5019	7.5931
75	91.76	0.001037	2.2172	384.36	2111.8	2496.1	384.44	2278.0	2662.4	1.2132	6.2426	7.4558
100	99.61	0.001043	1.6941	417.40	2088.2	2505.6	417.51	2257.5	2675.0	1.3028	6.0562	7.3589
101.325	99.97	0.001043	1.6734	418.95	2087.0	2506.0	419.06	2256.5	2675.6	1.3069	6.0476	7.3545
125	105.97	0.001048	1.3750	444.23	2068.8	2513.0	444.36	2240.6	2684.9	1.3741	5.9100	7.2841
150	111.35	0.001053	1.1594	466.97	2052.3	2519.2	467.13	2226.0	2693.1	1.4337	5.7894	7.2231
175	116.04	0.001057	1.0037	486.82	2037.7	2524.5	487.01	2213.1	2700.2	1.4850	5.6865	7.1716
200	120.21	0.001061	0.88578	504.50	2024.6	2529.1	504.71	2201.6	2706.3	1.5302	5.5968	7.1270
225	123.97	0.001064	0.79329	520.47	2012.7	2533.2	520.71	2191.0	2711.7	1.5706	5.5171	7.0877
250	127.41	0.001067	0.71873	535.08	2001.8	2536.8	535.35	2181.2	2716.5	1.6072	5.4453	7.0525
275	130.58	0.001070	0.65732	548.57	1991.6	2540.1	548.86	2172.0	2720.9	1.6408	5.3800	7.0207
300	133.52	0.001073	0.60582	561.11	1982.1	2543.2	561.43	2163.5	2724.9	1.6717	5.3200	6.9917
325	136.27	0.001076	0.56199	572.84	1973.1	2545.9	573.19	2155.4	2728.6	1.7005	5.2645	6.9650
350	138.86	0.001079	0.52422	583.89	1964.6	2548.5	584.26	2147.7	2732.0	1.7274	5.2128	6.9402
375	141.30	0.001081	0.49133	594.32	1956.6	2550.9	594.73	2140.4	2735.1	1.7526	5.1645	6.9171
400	143.61	0.001084	0.46242	604.22	1948.9	2553.1	604.66	2133.4	2738.1	1.7765	5.1191	6.8955
450	147.90	0.001088	0.41392	622.65	1934.5	2557.1	623.14	2120.3	2743.4	1.8205	5.0356	6.8561
500	151.83	0.001093	0.37483	639.54	1921.2	2560.7	640.09	2108.0	2748.1	1.8604	4.9603	6.8207
550	155.46	0.001097	0.34261	655.16	1908.8	2563.9	655.77	2096.6	2752.4	1.8970	4.8916	6.7886
600	158.83	0.001101	0.31560	669.72	1897.1	2566.8	670.38	2085.8	2756.2	1.9308	4.8285	6.7593
650	161.98	0.001104	0.29260	683.37	1886.1	2569.4	684.08	2075.5	2759.6	1.9623	4.7699	6.7322
700	164.95	0.001108	0.27278	696.23	1875.6	2571.8	697.00	2065.8	2762.8	1.9918	4.7153	6.7071
750	167.75	0.001111	0.25552	708.40	1865.6	2574.0	709.24	2056.4	2765.7	2.0195	4.6642	6.6837

Superheated water (*Continued*)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
	P = 4.0 MPa (250.35°C)				P = 4.5 MPa (257.44°C)				P = 5.0 MPa (263.94°C)			
Sat.	0.04978	2601.7	2800.8	6.0696	0.04406	2599.7	2798.0	6.0198	0.03945	2597.0	2794.2	5.9737
275	0.05461	2668.9	2887.3	6.2312	0.04733	2651.4	2864.4	6.1429	0.04144	2632.3	2839.5	6.0571
300	0.05887	2726.2	2961.7	6.3639	0.05138	2713.0	2944.2	6.2854	0.04535	2699.0	2925.7	6.2111
350	0.06647	2827.4	3093.3	6.5843	0.05842	2818.6	3081.5	6.5153	0.05197	2809.5	3069.3	6.4516
400	0.07343	2920.8	3214.5	6.7714	0.06477	2914.2	3205.7	6.7071	0.05784	2907.5	3196.7	6.6483
450	0.08004	3011.0	3331.2	6.9386	0.07076	3005.8	3324.2	6.8770	0.06332	3000.6	3317.2	6.8210
500	0.08644	3100.3	3446.0	7.0922	0.07652	3096.0	3440.4	7.0323	0.06858	3091.8	3434.7	6.9781
600	0.09886	3279.4	3674.9	7.3706	0.08766	3276.4	3670.9	7.3127	0.07870	3273.3	3666.9	7.2605
700	0.11098	3462.4	3906.3	7.6214	0.09850	3460.0	3903.3	7.5647	0.08852	3457.7	3900.3	7.5136
800	0.12292	3650.6	4142.3	7.8523	0.10916	3648.8	4140.0	7.7962	0.09816	3646.9	4137.7	7.7458
900	0.13476	3844.8	4383.9	8.0675	0.11972	3843.3	4382.1	8.0118	0.10769	3841.8	4380.2	7.9619
1000	0.14653	4045.1	4631.2	8.2698	0.13020	4043.9	4629.8	8.2144	0.11715	4042.6	4628.3	8.1648
1100	0.15824	4251.4	4884.4	8.4612	0.14064	4250.4	4883.2	8.4060	0.12655	4249.3	4882.1	8.3566
1200	0.16992	4463.5	5143.2	8.6430	0.15103	4462.6	5142.2	8.5880	0.13592	4461.6	5141.3	8.5388
1300	0.18157	4680.9	5407.2	8.8164	0.16140	4680.1	5406.5	8.7616	0.14527	4679.3	5405.7	8.7124
	P = 6.0 MPa (275.59°C)				P = 7.0 MPa (285.83°C)				P = 8.0 MPa (295.01°C)			
Sat.	0.03245	2589.9	2784.6	5.8902	0.027378	2581.0	2772.6	5.8148	0.023525	2570.5	2758.7	5.7450
300	0.03619	2668.4	2885.6	6.0703	0.029492	2633.5	2839.9	5.9337	0.024279	2592.3	2786.5	5.7937
350	0.04225	2790.4	3043.9	6.3357	0.035262	2770.1	3016.9	6.2305	0.029975	2748.3	2988.1	6.1321
400	0.04742	2893.7	3178.3	6.5432	0.039958	2879.5	3159.2	6.4502	0.034344	2864.6	3139.4	6.3658
450	0.05217	2989.9	3302.9	6.7219	0.044187	2979.0	3288.3	6.6353	0.038194	2967.8	3273.3	6.5579
500	0.05667	3083.1	3423.1	6.8826	0.048157	3074.3	3411.4	6.8000	0.041767	3065.4	3399.5	6.7266
550	0.06102	3175.2	3541.3	7.0308	0.051966	3167.9	3531.6	6.9507	0.045172	3160.5	3521.8	6.8800
600	0.06527	3267.2	3658.8	7.1693	0.055665	3261.0	3650.6	7.0910	0.048463	3254.7	3642.4	7.0221
700	0.07355	3453.0	3894.3	7.4247	0.062850	3448.3	3888.3	7.3487	0.054829	3443.6	3882.2	7.2822
800	0.08165	3643.2	4133.1	7.6582	0.069856	3639.5	4128.5	7.5836	0.061011	3635.7	4123.8	7.5185
900	0.08964	3838.8	4376.6	7.8751	0.076750	3835.7	4373.0	7.8014	0.067082	3832.7	4369.3	7.7372
1000	0.09756	4040.1	4625.4	8.0786	0.083571	4037.5	4622.5	8.0055	0.073079	4035.0	4619.6	7.9419
1100	0.10543	4247.1	4879.7	8.2709	0.090341	4245.0	4877.4	8.1982	0.079025	4242.8	4875.0	8.1350
1200	0.11326	4459.8	5139.4	8.4534	0.097075	4457.9	5137.4	8.3810	0.084934	4456.1	5135.5	8.3181
1300	0.12107	4677.7	5404.1	8.6273	0.103781	4676.1	5402.6	8.5551	0.090817	4674.5	5401.0	8.4925
	P = 9.0 MPa (303.35°C)				P = 10.0 MPa (311.00°C)				P = 12.5 MPa (327.81°C)			
Sat.	0.020489	2558.5	2742.9	5.6791	0.018028	2545.2	2725.5	5.6159	0.013496	2505.6	2674.3	5.4638
325	0.023284	2647.6	2857.1	5.8738	0.019877	2611.6	2810.3	5.7596				
350	0.025816	2725.0	2957.3	6.0380	0.022440	2699.6	2924.0	5.9460	0.016138	2624.9	2826.6	5.7130
400	0.029960	2849.2	3118.8	6.2876	0.026436	2833.1	3097.5	6.2141	0.020030	2789.6	3040.0	6.0433
450	0.033524	2956.3	3258.0	6.4872	0.029782	2944.5	3242.4	6.4219	0.023019	2913.7	3201.5	6.2749
500	0.036793	3056.3	3387.4	6.6603	0.032811	3047.0	3375.1	6.5995	0.025630	3023.2	3343.6	6.4651
550	0.039885	3153.0	3512.0	6.8164	0.035655	3145.4	3502.0	6.7585	0.028033	3126.1	3476.5	6.6317
600	0.042861	3248.4	3634.1	6.9605	0.038378	3242.0	3625.8	6.9045	0.030306	3225.8	3604.6	6.7828
650	0.045755	3343.4	3755.2	7.0954	0.041018	3338.0	3748.1	7.0408	0.032491	3324.1	3730.2	6.9227
700	0.048589	3438.8	3876.1	7.2229	0.043597	3434.0	3870.0	7.1693	0.034612	3422.0	3854.6	7.0540
800	0.054132	3632.0	4119.2	7.4606	0.048629	3628.2	4114.5	7.4085	0.038724	3618.8	4102.8	7.2967
900	0.059562	3829.6	4365.7	7.6802	0.053547	3826.5	4362.0	7.6290	0.042720	3818.9	4352.9	7.5195
1000	0.064919	4032.4	4616.7	7.8855	0.058391	4029.9	4613.8	7.8349	0.046641	4023.5	4606.5	7.7269
1100	0.070224	4240.7	4872.7	8.0791	0.063183	4238.5	4870.3	8.0289	0.050510	4233.1	4864.5	7.9220
1200	0.075492	4454.2	5133.6	8.2625	0.067938	4452.4	5131.7	8.2126	0.054342	4447.7	5127.0	8.1065
1300	0.080733	4672.9	5399.5	8.4371	0.072667	4671.3	5398.0	8.3874	0.058147	4667.3	5394.1	8.2819

L-1/T-2/NAME **Date : 07/02/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2014-2015

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**.

1. (a) Find the equivalent resistance between terminals 'A' and 'B' in the circuit shown in Fig. for Q. 1(a). **(18)**

   (b) Using source transformation find out the voltage 'V_0' in the circuit shown in Fig. for Q. 1(b). **(17)**

2. (a) Determine the power supplied by the source and I_x in the Fig. for Q. 2(a). **(17)**

   (b) Find I_0 using mesh analysis for the circuit shown in Fig. for Q. 2(b) **(18)**

3. (a) Using superposition principle, determine I_A in the circuit shown in Fig. for Q. 3(a). **(17)**

   (b) Find the value of R_L for maximum power transfer to R_L in the circuit shown in Fig. for Q. 3(b). Also find the value of maximum power delivered to the load. **(18)**

4. (a) Write down the necessary condition for voltage build up in a shunt dc generator. **(5)**

   (b) Derive and plot the torque-speed characteristic of a series dc motor. **(10)**

   (c) A 15-hp, 230-V, shunt dc motor with an armature resistance of 0.15 Ω and a field resistance of 170 Ω is driving a load with a line current of 60 A and an initial speed of 1800 rpm. The motor has compensating windings and the amount of armature current drawn by the motor remains constant. The magnetizing curve expressed in terms of E_A vs field current at 1800 rpm is given in the following table. **(20)**

E_A, V	150	180	215	221	226	242
I_F, A	0.88	1.00	1.28	1.35	1.44	2.88

   (i) What will be the motor's speed if the field resistance is raised to 180 Ω? Also find the induced torque for this condition.

   (ii) What is the no-load speed of the motor?

   (iii) What is the value of field resistance for obtaining speed of 1750 rpm?

Contd P/2

EEE 161

SECTION – B

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

Symbols have their usual meaning.

5. (a) Write down the characteristics of an ideal transformer. **(5)**

(b) A 15 kVA, 2300/230-V transfer is to be tested to determine its excitation branch components, its series impedances, and its voltages regulation. The following test data have been taken from the primary side. **(20)**

Open Circuit Test	Short-Circuit Test
$V_{OC} = 2300$ V	$V_{SC} = 47$V
$I_{OC} = 0.21$ A	$I_{SC} = 6.00$ A
$P_{OC} = 50$ W	$P_{SC} = 160$ W

Draw the equivalent circuit of this transformer referred to the high voltage side and low voltage side. Calculate the full load voltage regulation at 0.8 lagging power factor.

(c) Can voltage regulation of a transformer be negative? Explain your answer with phasor diagram. **(10)**

6. (a) In the balanced three-phase Y-Δ system in Fig. for Q. No. 6(a) find the line current I_L, phase current I_P and total power loss in the line. **(17)**

(b) One balanced motor and one balanced capacitive load are connected to a 240 kV rms 60-Hz line, as shown in Fig. for Q. No. 6(b). The motor draws 30 kW at a power factor of 0.6 lagging, while the load draws 45 kVAR at a power factor of 0.8 leading. Assuming *abc* sequence, determine **(18)**

(i) the line currents

(ii) the complex, real and reactive powers absorbed by the combined load.

7. (a) Find i_0 in the circuit of Fig. for Q. No. 7(a) using superposition. **(18)**

(b) Calculate the voltage at nodes 1 and 2 in the circuit of Fig. for Q. No. 7(b) using nodal analysis. **(17)**

8. (a) For a balanced 3-phase load, (Δ or Y connected), prove that P = $\sqrt{3}\, V_L I_L \cos\theta$, where symbols have their usual meaning. **(5)**

(b) Draw the appropriate phasor diagram of the circuit shown in Fig. for Q. No. 8(b) . Use the voltage v_c as reference. What is the current through the capacitor? **(13)**

(c) Find the value of Z_L for maximum power transfer to Z_L in Fig. for Q. No. 8(c). What is the maximum absorbed power? What is the absorbed power if a load of $Z_L/2$ is used? **(17)**

EEE 161

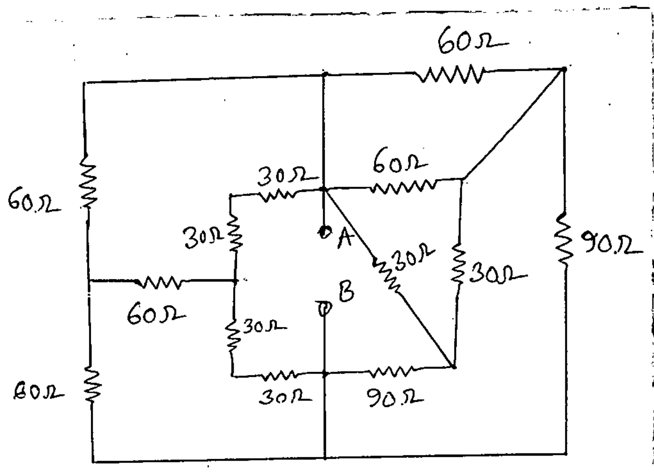


Fig. for Q. 1(a)

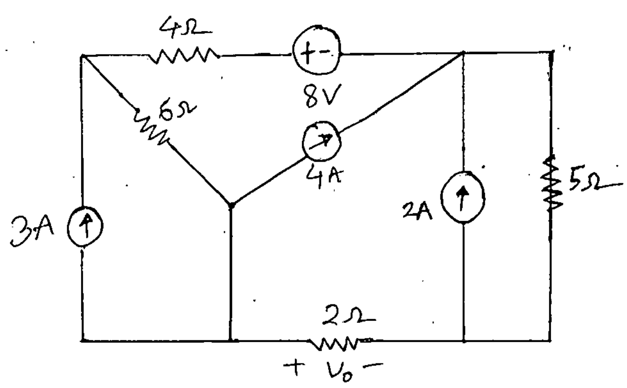


Fig. for Q. 1(b)

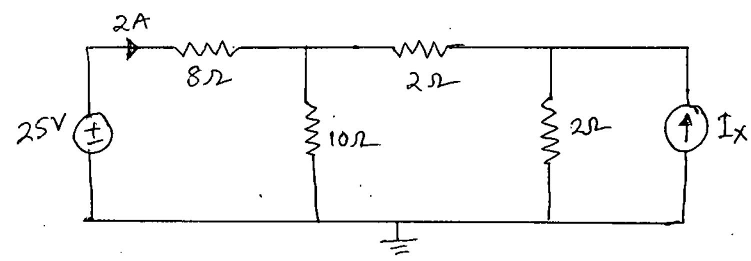


Fig. for Q. 2(a)

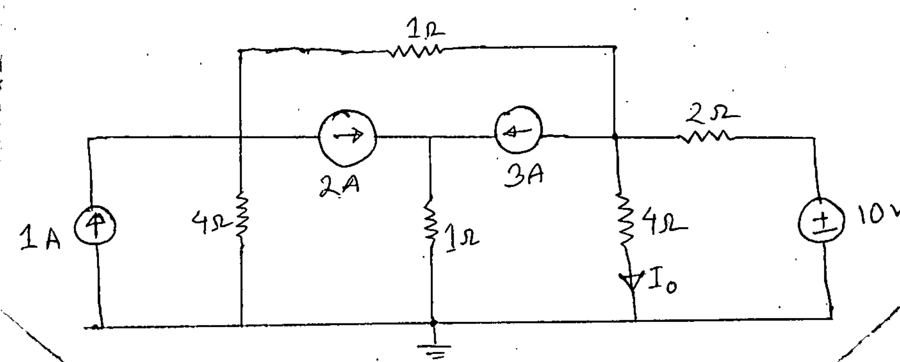


Fig. for Q. 2(b)

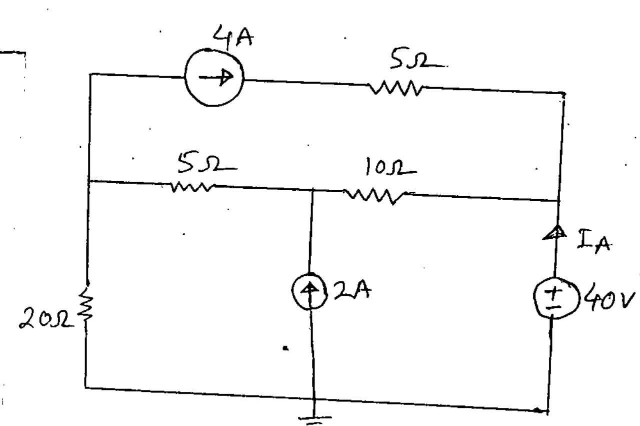


Fig. for Q. 3(a)

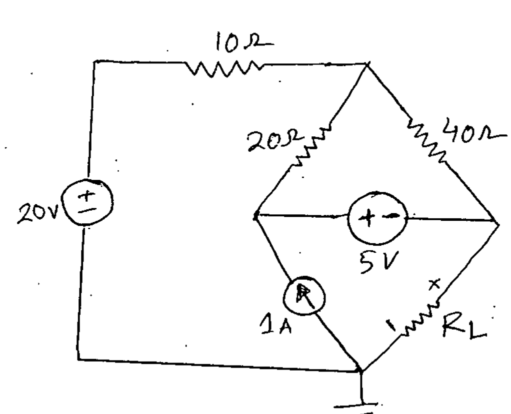


Fig. for Q. 3(b)

EEE 161

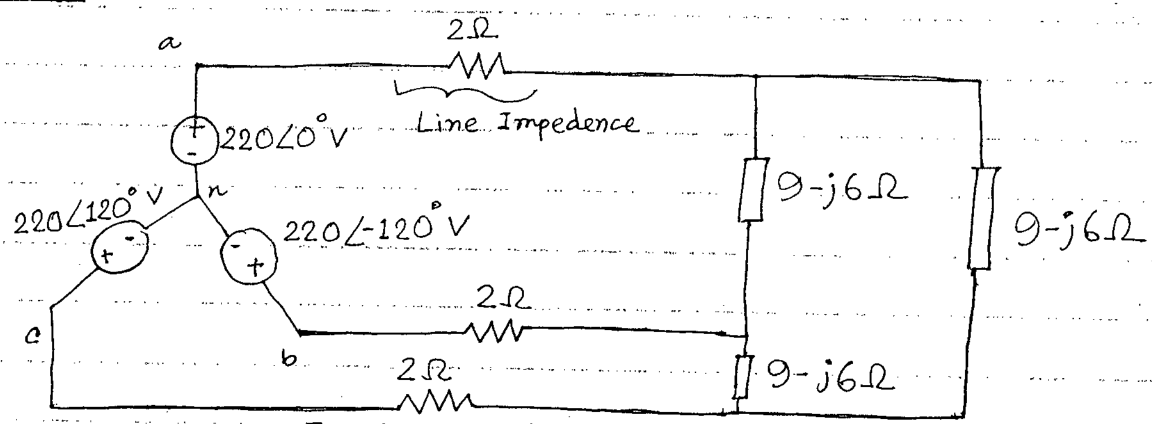


Fig. for Q. No. 6(a)

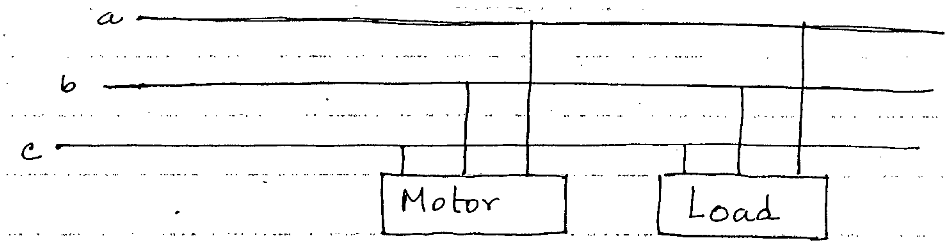


Fig. for Q. No. 6(b)

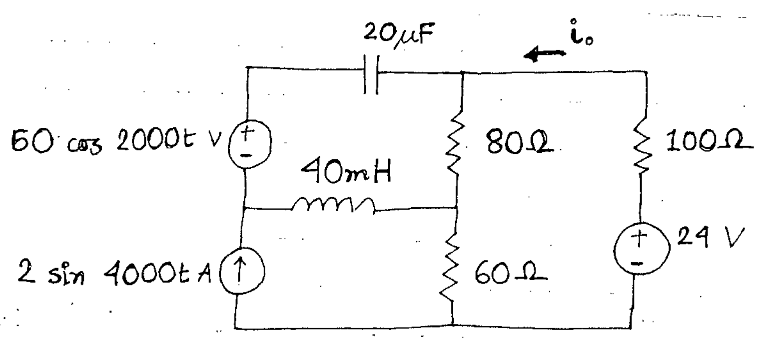


Fig. for Q. No. 7(a)

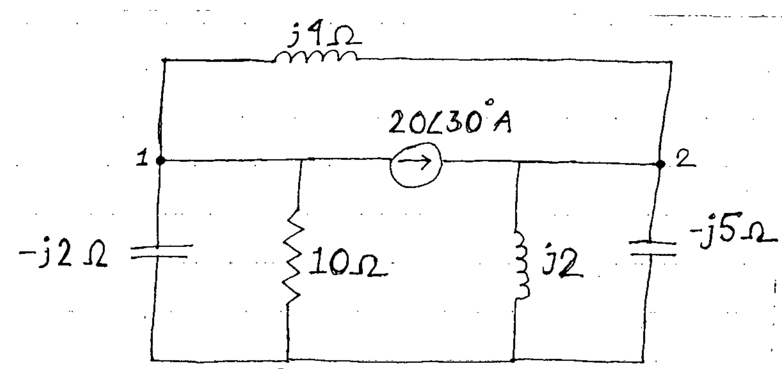


Fig. for Q. No. 7(b)

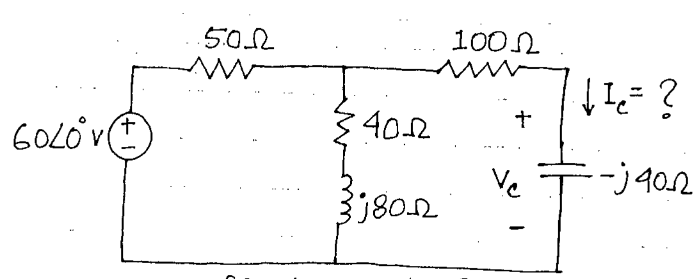


Fig for Q. No. 8(b)

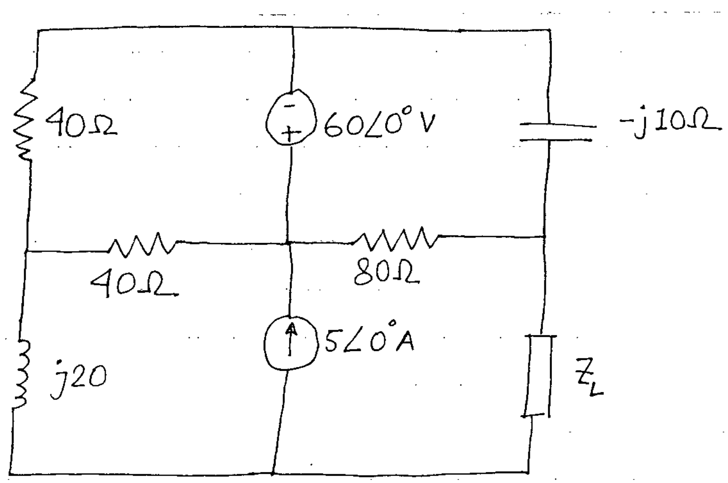


Fig for Q. No. 8(c)