29.09.2013

L-1/T-2/NAME

Date : 29/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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) Using Continuity and Bernoulli equation, derive an expression which can be used to measure the actual flow in a venturimeter. Show that if the pressure is measured using a manometer, then the inclination of the meter is not relevant. **(15)**

   (b) Determine the magnitude and direction of the force on the double nozzle as shown in Fig. 1(b). Both nozzle jets have a velocity of 12 m/s. The axes of the pipe and both nozzles all lie in a horizontal plane. Take $\gamma = 9810$ N/m^3 and neglect friction. **(20)**

2. (a) Define the following terms: **(3×4=12)**

   (i) Critical Reynold's number

   (ii) Hydraulically smooth and rough pipe

   (iii) HGL and EGL

   (iv) NPSH

   (b) The hydraulic dredger shown in Fig. 2(b) is used to dredge sand from a river bottom. Estimate the thrust needed from the propeller to hold the boat stationary. Assume the specific gravity of the sand/water mixer is 1.2. **(12)**

   (c) 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 Fig. 2(c). The pipe has a diameter of 5.0 cm. would you expect the paint to exit the pipe as green paint? Explain; Repeat the problem if the paint were 'thinned' so that it is only 10 times more viscous than water. Assume that the density remain same and $\mu = 1.13 \times 10^{-3}$ N s/m^2 for water. **(11)**

3. (a) The diagram in Fig. 3(a) shows water leaving a tank through an inverted v-tube. All answers to be given in SI units. Determine: **(25)**

   (i) the velocity at which water leaves the tank

   (ii) the mass flow-rate at which water leaves the tank

   (iii) the pressure at point B in Pa

   (iv) Given that the diameter at the constriction is 2.4 inch, determine the pressure at point A.

   (v) Given that the water is at 50°C and that the vapour pressure of water is 12.3 kPa at that temperature. Justify whether cavitation is likely to occur at A?

   (b) Water is flowing at the rate of 300 l/s through a 90° v-notch. Find the position of the apex of 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)**

Contd P/2

NAME 123

4. (a) What is boundary layer? Briefly describe how boundary layer is formed. **(12)**

   (b) Water is pumped with a centrifugal pump and when the flow rate is 0.01514 m^3/s the total power consumption is 4.48 kW. Determine the pump head if the efficiency is 62%. **(5)**

   (c) Two reservoirs are connected by 800 m long commercial pipe of 300 mm diameter. In the pipe line, there are four standard elbows (k = 0.9) and a globe valve (k = 10). If the flow rate of water is 0.30 m^3/s, find the difference of water levels between the two reservoirs. The kinematic viscosity of water is 1.02×10^{-6} m^2/s. (Take pipe surface roughness, ϵ = 0.000046 m) **(18)**

SECTION – B

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

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

   (b) Find the minimum value of z for which the gate in the figure will rotate counter clock wise if the gate is **(20)**

   (i) rectangular, 1.2 by 1.2 m;

   (ii) triangular, 1.2 m base as axis, height 1.2 m Neglect friction in bearings.

6. (a) Find the difference of pressure between vessels A and B as shown in figure. **(10)**

   (b) As a first approximation, any floating object can be regarded as being made of uniform density, ρ and having a rectangular cross section with width, W and height, h. Consider an object of width W = 2.0 m and specific gravity, β = 0.85. What is the maximum allowable height of the object so that it will remain stable in the orientation shown in the position shown in the diagram? How much of the object would be below the surface when the object has its maximum allowable height? **(20)**

   (c) Mention the limitations of Bernoulli's equation. **(5)**

7. (a) The thrust force, F developed by a free propeller, either aircraft or marine depends on the fluid density ρ the rotation rate ω, the diameter D and the forward velocity V. Viscous effects are slight and can be neglected. By using the method of repeating variables show that

$$\frac{F}{\rho V^2 D^2} = G\left(\frac{\omega D}{V}\right)$$

   Where G is a function.

Contd P/3

NAME 123

Contd ... Q. No. 7(a)

Tests of a model aircraft propeller are done in a wind tunnel with air of density 1.22 kg/m^3. The propeller diameter is 10.0 cm. The test yield the following data for air at a velocity of 20 m/s.

Rotation (rev/min)	4800	6000	7000	8000
Thrust (N)	6.1	19	30	42

Plot this data. Predict the thrust in N of a geometrically similar 1.42 m propeller when rotating at 3200 rev/min, flying at 500 km/hr at an altitude of 4000 m where the air density is 1.022 kg/m^3. **(25)**

(b) Define: **(2×5=10)**

(i) Compressible flow

(ii) Incompressible flow

(iii) Steady flow

(iv) Unsteady flow

(v) Gravity flow

8. (a) A 1:25 model of a submarine is tested in a wind tunnel. If the speed of prototype is 12 m/s, find the speed of air in wind tunnel. Find also the ratio of drag forces between the prototype and its model. The kinematic viscosities of air and sea water are 0.015×10^{-4} m^2/s and 0.012×10^{-4} m^2/s respectively. The densities of sea water and air are 1030 kg/m^3 and 1.24 kg/m3 respectively. **(12)**

(b) In the figure, the diameter of the vertical pipe is 10.00 cm, and that of the stream discharging into the air at E is 7 cm. Neglecting the loss of energy, what are the pressure heads at B, C, and D? **(13)**

(c) State and explain the physical significance of Reynold's number and Froude's number in fluid flow. **(10)**

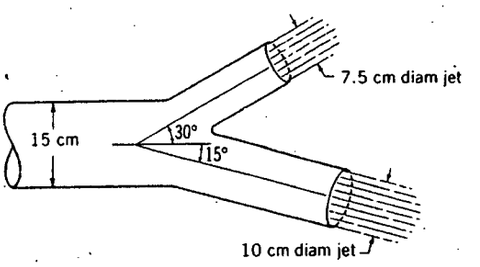

Fig. for Q. NO. 1(b)

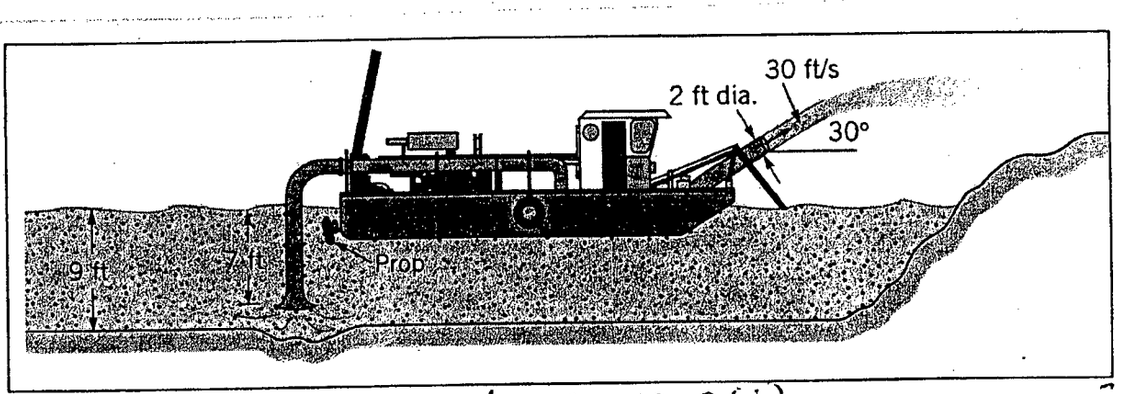

Fig. for Q. NO. 2(b)

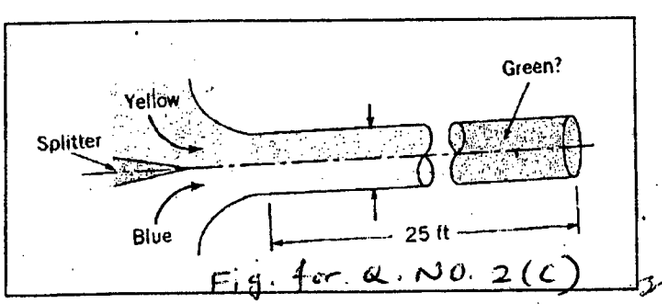

Fig. for Q. NO. 2(c)

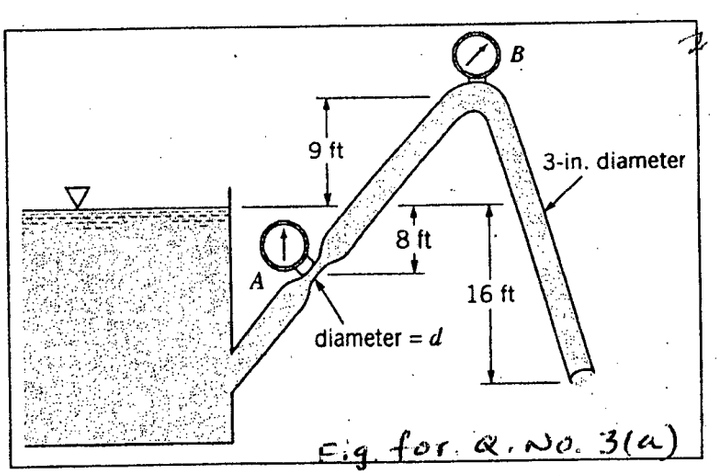

Fig. for Q. NO. 3(a)

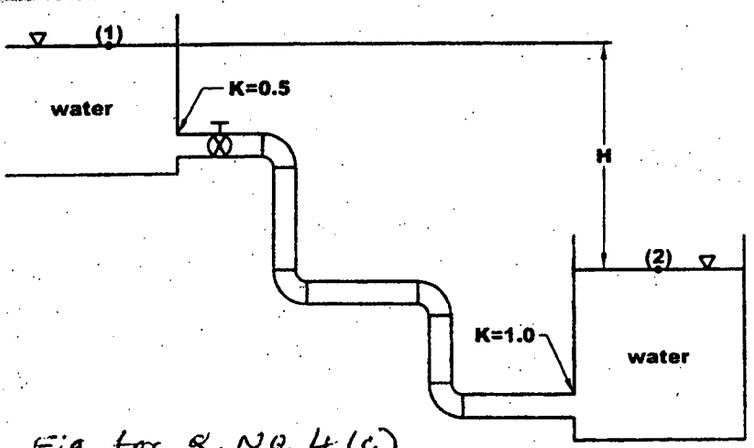

Fig. for Q. NO. 4(c)

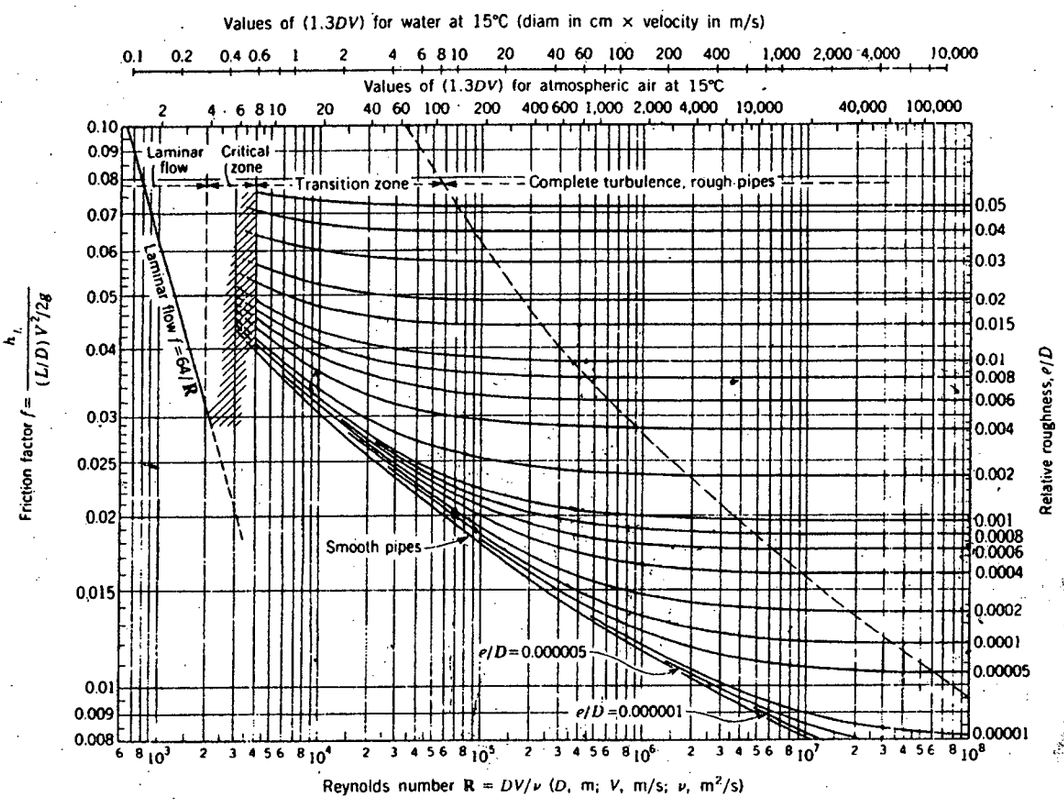

Figure . . . Friction factor for pipes (Moody diagram).

For. Q. NO. 4(c)

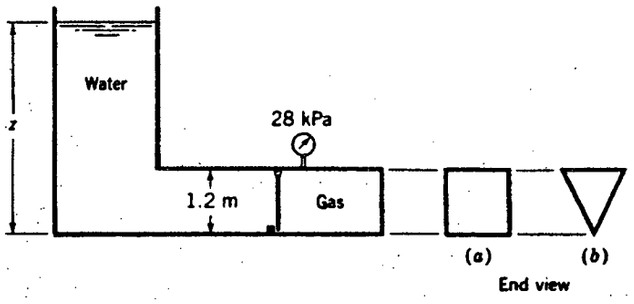

Figure for Question no. 5(b)

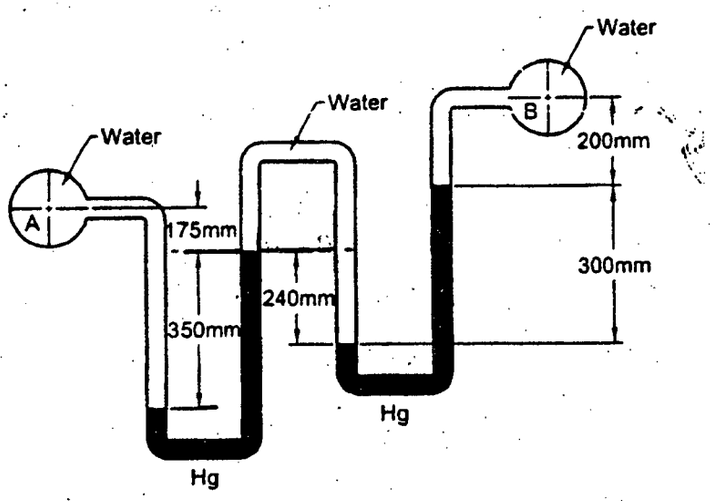

Figure for Question no. 6(a)

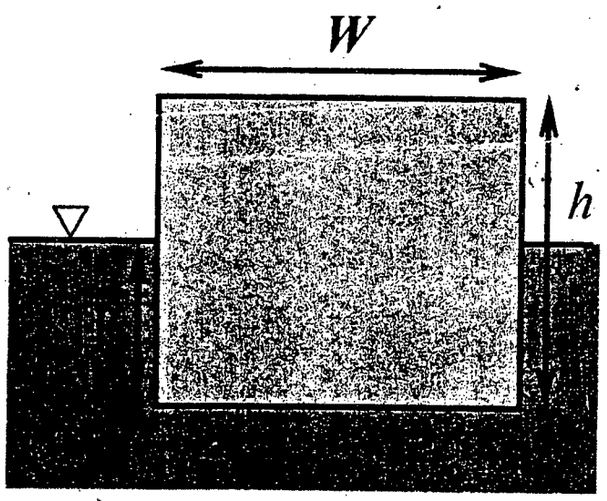

Figure for Question no. 6(b)

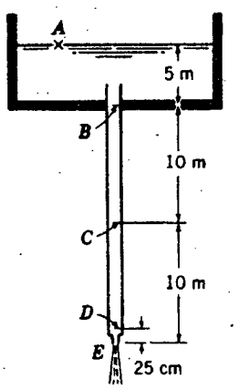

Figure for Question no. 8(b)

25.7.14

L-1/T-2/NAME

Date : 23/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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) What is a system? Classify systems and make comparison among them. **(3+7)**

   (b) Define quasi-static process. Explain quasi-static process with example. **(3+5)**

   (c) What is a pure substance? "Air is not a pure substance" – comment on this statement with proper logic. **(3+4)**

   (d) What is triple point? Can a pure substance have a number of triple points? Show the phase diagram of a substance that contracts on freezing. **(2+3+5)**

2. (a) Derive the steady-state steady-flow (SSSF) energy equation. List the assumptions made in its derivation. **(20)**

   (b) The refrigerator shown in Fig. 2(b) uses R-134a as the working fluid. The mass flow rate through each component is 0.1 kg/s, and the power input to the compressor is 5.0 kW. The following state data are known, **(15)**

   $P_1 = 100$ kPa, $T_1 = -20$ °C

   $P_2 = 800$ kPa, $T_2 = 50$ °C

   $T_3 = 30$ °C, $x_3 = 0.0$

   $T_4 = -25$ °C.

   With the necessary assumptions, determine the followings:

   (i) The quality at the evaporator inlet.

   (ii) The rate of heat transfer to the evaporator,

   (iii) The rate of heat transfer from the compressor.

3. (a) What is Clausius inequality? What are the factors that render process irreversible? **(5+5)**

   (b) Define entropy of a system, **(15)**

   "The entropy of any closed system (control mass) which is thermally isolated from the surroundings either increase or, if the process undergone by the system is reversible, remains constant" – Justify it.

   (c) An inventor claims to have developed a power cycle operating between hot and cold reservoirs at 1175K and 295K, respectively, that provides a steady-state power output of 32 kW while receiving energy by heat transfer from hot reservoir at the rate 150,000 kJ/h. Evaluate this claim. **(10)**

Contd P/2

ME 169 (NAME)

4. (a) Briefly discuss the effect of pressure and temperature on the Rankine cycle. **(15)**

(b) Water is the working fluid in a Rankine cycle. The water vapor enters the turbine at 10 MPa, 480 °C, and the condenser pressure is 6 kPa. The turbine and pump have isentropic efficiencies of 80% and 70% respectively. With proper assumptions and T-s diagram, determine for the cycle: **(20)**

(i) the back work ratio,

(ii) the thermal efficiency,

(iii) the rate of heat transfer from the working fluid passing through the condenser to the cooling water, in kJ/kg of steam flowing.

Draw the schematic diagram also.

SECTION – B

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

5. (a) With a rough sketch show the different components of a single cylinder petrol engine. **(10)**

(b) What are the differences between two stroke and four stroke engines? Describe their uses. **(10)**

(c) What do you mean by 'air-standard Otto cycle'? Derive an expression for efficiency and discuss. **(15)**

6. (a) What is air-standard Brayton cycle? Derive expression for the efficiency and discuss. **(8)**

(b) What do you mean by 'Irreversibility' in a gas turbine? Describe with sketches and examples. **(5)**

(c) Describe the application of gas turbine in air-craft propulsion. **(5)**

(d) In an air-standard Brayton cycle, the air enters the compressor at 0.1 MPa 15 °C. The pressure at the exit of the compressor is 1.0 MPa and the maximum temperature in the cycle is 1100 °C. Determine **(17)**

(i) the pressure and temperature at each terminal point in the cycle.

(ii) the compressor work, turbine work, net work developed and thermal efficiency.

(iii) Discuss your findings.

7. (a) Give a rough sketch of a stirling bent-water tube boiler and label its components. **(8)**

(b) What are the differences between water tube and fire tube boilers? Describe. **(7)**

(c) Describe with sketches the working principle of water-level indicator and spring loaded safety valve. **(10)**

(d) What are the differences between economizer, air pressure and superheater? Describe. **(10)**

8. (a) What are the differences between impulse and reaction turbines. **(5)**

(b) What is staging of steam turbine? What are the differences between pressure and velocity compounding? Mention its specific features and advantages? **(20)**

(c) Describe the losses in a steam turbine. **(10)**

L-1/T-2/NAME

Date : 06/10/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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

Full Marks: 210 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) Derive the time independent form of the Schrödinger equation for a particle of mass 'm' moving in potential energy 'V'. **(13)**

   (b) Show that $\frac{\partial \rho}{\partial t} + \underline{\nabla}.\underline{J} = 0$, where their symbols have usual meanings. **(10)**

   (c) (i) Find the probability current density carried by a plane wave Ae^{ikx} in one dimension. **(6)**

   (ii) Show that [H, p] = 0, H is the free particle Hamiltonian operator and p is the momentum operator, justify it. **(6)**

2. (a) What do you mean by 'eigenfunction and eigenvalue'? **(8)**

   (b) Write the Schrödinger equation for the linear harmonic oscillator and show that ground state energy, $E_0 = \frac{1}{2}\hbar W_0$, where the symbols have their usual meanings. **(17)**

   (c) Define simultaneous eigenfunction with example. Show that two operators have simultaneous eigenfunction if they commute. **(10)**

3. (a) What is phase space? What is boson? What do you mean by Bose temperature, (T_B)? **(10)**

   (b) What is fermion? Deduce an expression for the 'Fermi energy' and 'Fermi velocity' for the free electrons in a metal at absolute zero. **(18)**

   (c) The Fermi energy for sodium at absolute zero is 3.1 eV. Find its value for aluminium given that the free electron density in aluminium is approximately 7 times that in sodium. **(7)**

4. (a) Show that the total energy of a particle executing simple harmonic motion is proportional to the square of the amplitude of the motion. **(15)**

   (b) What is a torsion pendulum? Show that for small angular displacement, the oscillation of a torsion pendulum is simple harmonic. **(10)**

   (c) A particle performs simple harmonic motion given by **(10)**

   $$y = 20\sin(\omega t + \phi)$$

   If the time period is 30 seconds and the particle has a displacement of 10 cm at t = 0, find (i) epoch, (ii) the phase angle at t = 5 seconds and (iii) the phase difference between two positions of the particle 15 seconds apart.

Contd P/2

PHY 161

SECTION – B

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

5. (a) Derive a general expression for the resultant vibration of a particle simultaneously acted upon by two initially perpendicular simple harmonic vibrations having the same time period but different amplitudes and phase angles. What happens if the phase difference is (i) 0, (ii) $\pi/4$, (iii) $3\pi/4$ and (iv) π radians? **(20)**

(b) Two simple harmonic motions acting simultaneously on a particle are given by **(15)**

$$y_1 = \sin\left(\omega t + \pi/3\right)$$

$$y_2 = 2\sin \omega t$$

Calculate (i) amplitude and (ii) phase constant of resultant vibration, (iii) what is the equation of resultant vibration?

6. (a) Establish the differential equation of damped harmonic oscillator. **(10)**

(b) Obtain an expression for the displacement in the case of a damped oscillatory motion. Discuss the conditions under which the oscillations become aperiodic, critically damped and oscillatory. **(20)**

(c) A particle of mass 3 g is subjected to an elastic force of 48 dyne-cm^{-1} and a damping force of 12 dyne-cm^{-1}.sec. If the motion is oscillatory, find its period. **(5)**

7. (a) What is spherical aberration? Explain a method by which you can remove it. **(2+5=7)**

(b) Find the expressions of longitudinal chromatic aberration for object placed at (i) infinity and (ii) a finite distance. **(14)**

(c) (i) What do you mean by the circle of least confusion (CLC)? **(2+12=14)**

(ii) If a parallel beam of light is incident on a lens, then show that the thickness "d" of CLC depends on the aperture thickness and dispersive power of the lens.

8. (a) (i) Define cardinal points of a system of co-axial lenses. (ii) Prove that for a combination of two thin lenses in contact, having focal lengths f_1 and f_2, the focal length (f) of the equivalent lens is given by: $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$. **(3+14=17)**

(b) What is achromatism? Obtain the condition for achromatism of two lenses placed in contact. **(3+15=18)**

L-1/T-2/NAME

Date : 08/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

SECTION – A

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

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. **(18)**

   (b) If the two straight lines represented by $(\tan^2\phi+\cos^2\phi)x^2-2xy\tan\phi+y^2\sin^2\phi=0$ make angles α and β with axis of x, find the value of $\tan\alpha-\tan\beta$. **(17)**

2. (a) Prove that the straight lines represented by the equation $ax^2+2hxy+by^2+2gx+2fy+c=0$ will be equidistant from the origin, if $f^4-g^4=c(bf^2-ag^2)$. **(18)**

   (b) If one of the straight lines represented by the equation $ax^2+2hxy+by^2=0$ is perpendicular to one of the lines represented by $a_1x^2+2h_1xy+b_1y^2=0$ find the value of $(aa_1-bb_1)^2+4(ah_1+b_1h)(a_1h+bh_1)$. **(17)**

3. (a) Prove that the two circles each of which passes through $(0,k)$ and $(0,-k)$ and touch the line $y=mx+c$ will cut orthogonally, if $c^2=k^2(2+m^2)$. **(18)**

   (b) Prove that the two straight lines, one a tangent to the parabola $y^2=4a(x+a)$ and the other to the parabola $y^2=4a_1(x+a_1)$ which are at right angles to one another meet on the straight line $x+a+a_1=0$. **(17)**

4. (a) Find the locus of the middle point of the chord of contact of tangents drawn to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ from any point on the director circle of the ellipse. **(18)**

   (b) Find the equation of the hyperbola which has the lines $x+4y-5=0$ and $2x-3y+1=0$ for its asymptotes and which passes through the point (1, 2). **(17)**

Contd P/2

MATH 183

SECTION – B

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

5. (a) Form a differential equation of the least order by eliminating arbitrary constants a,b,c from the equation $y = ae^{5x} + be^{3x} + ce^{x}$. **(12)**

(b) Solve the following differential equations: **(10+13)**

(i) $\sqrt{(1+x^2)(1+y^2)}\,dx + xy\,dy = 0$

(ii) $(2xy+3y^2)dx - (2xy+x^2)dy = 0$ given that $y(1)=1$.

6. (a) Solve the following ordinary differential equations: **(10+10)**

(i) $(2x+y-3)dy - (x+2y-3)dx = 0$

(ii) $\frac{dy}{dx} = \frac{x\sqrt{x^2-1}+y}{\sqrt{x^2-1}}$ with $y(1)=1$.

(b) A circuit has in series an electromotive force given by $E = 100\sin 60t$ volts, a resistor of 2 ohms, an inductor of 0.1 henry and a capacitor of $\frac{1}{260}$ farads. If the initial current and the initial charge on the capacitor are both zero, find the charge on the capacitor at any time $t > 0$. **(15)**

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

(i) $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 16x^2e^{2x}\cos 2x$ **(13)**

(ii) $\frac{d^2y}{dx^2} - y = \frac{2}{1+e^x}$ **(12)**

(iii) $x^2\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 4y = x + x^2\ln x$ **(10)**

8. (a) Find the general solution of the differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = \frac{e^{-x}}{x^2}$. **(15)**

(b) Solve the following differential equations: **(10+10)**

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

(ii) $(12y+4y^3+6x^2)dx + 3(x+xy^2)dy = 0$.

L-1/T-2/NAME

Date : 24/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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) Derive the relationship between turns ratio and power rating of two-winding transformer when reconnected as autotransformers. **(5)**

(b) The equivalent low-side parameters of a 300 KVA, 4200-480 V, 50 Hz transformer are $R_{eq,LS}$ = 0.0092 Ω and $X_{eq,LS}$ = 0.0433 Ω. The transformer is operating in the step-down mode and is delivering rated current at rated voltage to a 0.85 power factor lagging load. Determine: (i) no-load voltage, (ii) voltage regulation. **(10)**

(c) The following test data were obtained from short circuit and open-circuit tests of a 50 KVA, 2400-600 V, 50 Hz transformer. **(20)**

Open Circuit Test	Short Circuit Test
V_{OC} = 600 V	V_{SC} = 76.4 V
I_{OC} = 3.34 A	I_{SC} = 20.8 A
P_{OC} = 484 W	P_{SC} = 754 W

Draw the approximate equivalent circuit for this transformer.

2. (a) Derive the expression for torque-speed relationship of a shunt DC motor. **(10)**

(b) Explain how speed of a shunt DC motor is controlled by adjusting the field resistance. **(10)**

(c) Explain how voltage builds up in a shunt DC generator. Discuss two possible causes for voltage to fail to build up during starting in shunt DC generator. **(7+8)**

3. (a) Find I_{aA}, I_{bB} and I_{cC} for the 3-phase circuit shown in Fig. for Q. 3(a). Also find V_{AB}, V_{BC} and V_{CA}. **(20)**

Fig. for Q. 3(a)

Contd P/2

EEE 161

Contd ... Q. No. 3

(b) Find I, V_R, V_L and V_C for the circuit shown in Fig. for Q. 3(b). Draw the complete phasor diagram of the circuit. Also calculate the power factor of the complete circuit. **(15)**

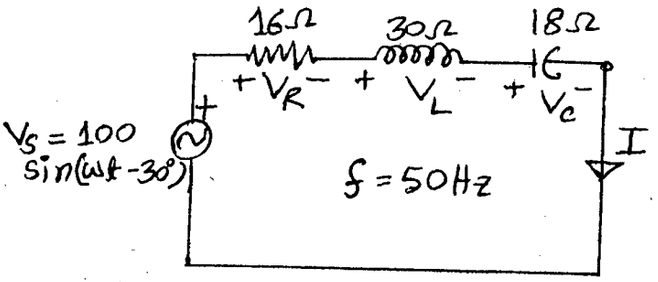

Fig. for Q. 3(b)

4. (a) The current taken from a 230 V, 50 Hz supply to a circuit is measured as 20 A with a lagging power factor of 0.75. Calculate the apparent power, real power and reactive power. Also calculate the amount of capacitance that must be connected in parallel with the load to correct the power factor to 0.95 lagging. **(18)**

(b) Calculate V_1 and V_2 for the circuit shown in Fig. for Q. 4(b) using nodal analysis. **(17)**

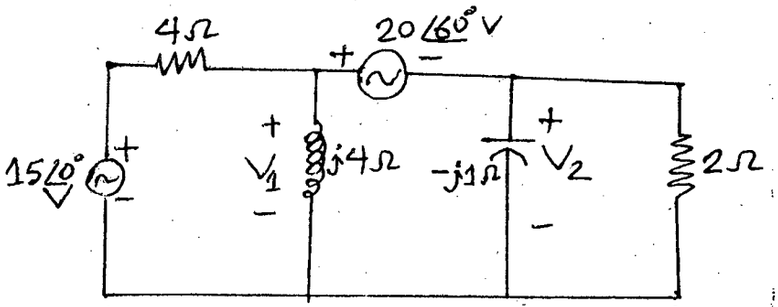

Fig. for Q. 4(b)

SECTION – B

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

5. (a) Find the equivalent resistance R_{ab} for the network shown in Fig. for Q. 5(a). Each of the resistance is 10 Ω. Also find the current supplied by the voltage source. **(12+3)**

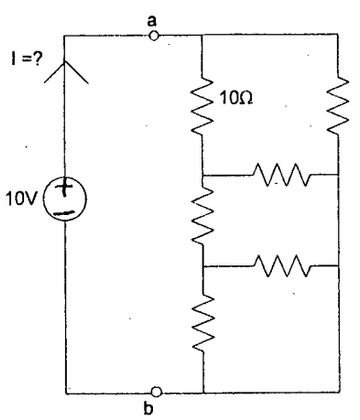

Figure for Q. 5(a)

Contd P/3

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Contd ... Q. No. 5

(b) Use source transformation to find voltage v_0 in the circuit shown in Fig. for Q. 5(b). Also find the power absorbed in 5 Ω resistance. **(16+4)**

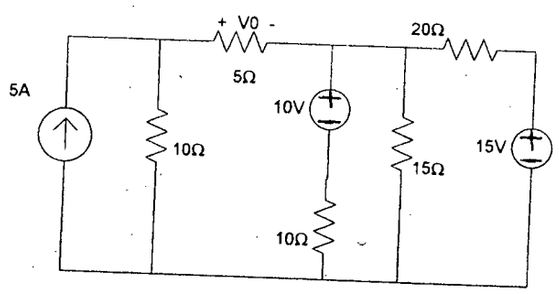

Figure for Q. 5(b)

6. (a) Find the power absorbed by all the resistance in the network shown in Fig. for Q. 6(a) using mesh analysis. **(20)**

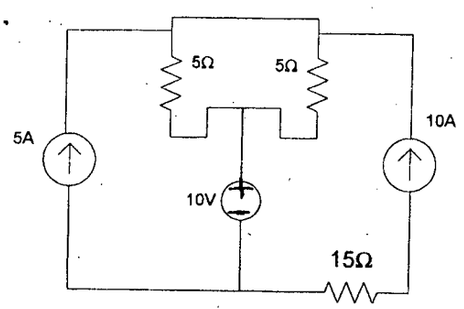

Figure for Q. 6(a)

(b) Using node analysis, find out how much power the current source delivers to the circuit shown in Fig. for Q. 6(b). Find out the power absorbed by each resistance. Each of the resistances is 10 Ω. **(15)**

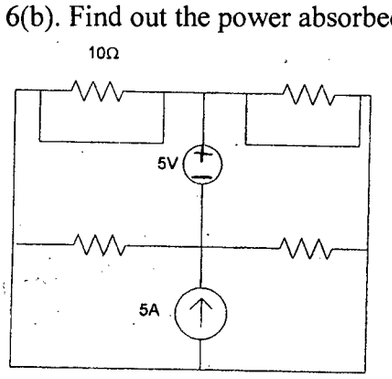

Figure for Q. 6(b)

7. (a) Find the value of R_L for maximum power transfer to the load (R_L) in the circuit shown in Fig. for Q. 7(a). Also find the maximum power that can be delivered to the load. **(15+5)**

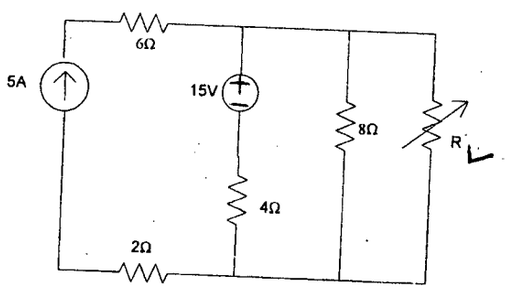

Figure for Q. 7(a)

Contd P/4

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Contd ... Q. No. 7

(b) Find the current I of the network shown in Fig. for Q. 7(b) using superposition theorem. **(15)**

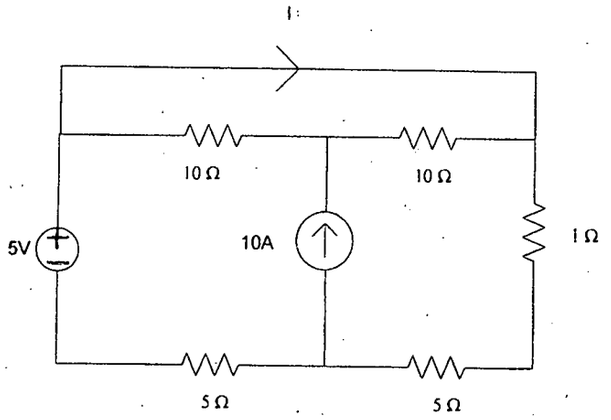

Figure for Q. 7(b)

8. (a) Find the Thevenin equivalent circuit seen at terminals a-b for the circuit depicted in Fig. Q. 8(a). **(20)**

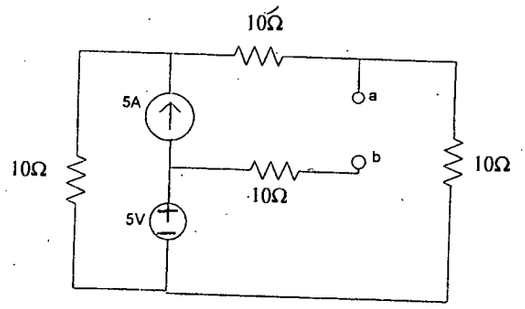

Figure for Q. 8(a)

(b) Prove that the maximum power will be transferred to the load when $R_L = R_{th}$. The symbols have their usual meaning. Also find the expression of maximum power transfer to the load. **(15)**
