L-1/T-2/BME **Date : 16/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **BME 103** (Introduction to Living Cells and Human Anatomy)

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) With diagram, describe in detail the arrangement of protein and lipids in a cell membrane. Mention the functions of cell membrane. **(6+5)**

   (b) Differentiate between prokaryotic and eukaryotic cells. **(4)**

   (c) Compare different types of cytoskeleton in tabular form. What are the clinical aspects of intermediate filaments? **(6+2)**

   (d) Which one is the most important organelle of a cell? Explain why you think that it is the most important one. **(6)**

   (e) Explain how cellular organelles participate in defense mechanism. **(6)**

2. (a) What are the characteristics features of synovial joints? With example, mention different types of synovial joints. **(4+10)**

   (b) There are four types of functionally voluntary muscles. They are prime mover, antagonist, fixator, and synergist. Describe (i) the muscle that play a major role in achieving the desired movement, and (ii) the muscle that work together to cause a movement. **(4+4)**

   (c) Write down the functions of the skeletal muscle. **(6)**

   (d) The gastrocnemius muscle is present in the back part of the lower leg, and primarily involved in running and jumping movements of leg. With characteristics, explain which type of muscle (red or white) predominantly presents in the gastrocnemius muscle. **(7)**

3. (a) Write down the functions of thoracic cage. **(5)**

   (b) Briefly explain the respiratory movements and their mechanism. **(9)**

   (c) Draw and label the oblique section of heart through interatrial and interventricular septa. **(8)**

   (d) Write in brief about the conducting system of heart. **(4)**

   (e) Write down the actions of sympathetic and parasympathetic nerves on heart. **(4)**

   (f) Write down the beginning and termination of oesophagus mentioning level of constrictions. **(5)**

Contd P/2

BME 103

4. (a) Mention at least eight differences between right and left lung. **(12)**

(b) Why the breath sound over the right lung is more audible? Why a foreign body is more likely to be aspirated to the right lung? **(3+3)**

(c) Mention the differences in children and adult trachea. **(5)**

(d) Write a note on thoracic mediastinum. Name the four sub-divisions of the mediastinum, and mention contents of any of two sub-divisions. **(12)**

SECTION – B

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

5. (a) Name the joints form by the bones of upper limb with their types. **(10)**

(b) Write about the functions of arches of foot. **(4)**

(c) Give an account of the formation of (i) hip joint (ii) knee joint. **(3+3)**

(d) Name the bones of face and skull. Mention the characteristic features and functions of pneumatic bone. **(10+5)**

6 (a) Draw and label the parts of extrahepaticbiliary apparatus. **(5)**

(b) Name the parts of small and large intestine. Give the differences between small intestine and large intestine. **(4+5)**

(c) Name the parts of functional unit of kidney. Mention the functions of kidney. Write a note on make urethra. **(4+4+3)**

(d) What are the male and the female reproductive organs? **(10)**

7 (a) Write about the extension and parts of pharynx. Mention the functions of different parts of pharynx. **(5+5)**

(b) What are the laryngeal cartilages? Name the structures responsible for production of voice. **(4+6)**

(c) Write the contents of (i) vertebral canal (ii) cranial cavity (iii) orbit. **(5×3=15)**

8. (a) Name the cranial nerves. Explain how brain is protected. **(6+4)**

(b) How brainstem is formed? Mention the level of termination of spinal cord in infant and adult. **(4+4)**

(c) Write about the functions of (i) cerebellum (ii) reticular formation. **(4+4)**

(d) Write short notes on (i) parts of ear (ii) functions of auditory tube. **(6+3)**

L-1/T-2/BME **Date : 22/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **MATH 115** (Complex Variable and Vector Calculus)

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) Show that if z lies on the circle $|z| = 2$, then $\left|\frac{1}{z^4 - 4z^2 + 3}\right| \le \frac{1}{3}$ **(5)**

(b) Determine where $f'(z)$ exists and find its value, when **(10)**

(i) $f(z) = z\, Im\, z$

(ii) $f(z) = x^3 + i(i - y)^3$

(c) Show that the function **(10)**

$$f(z) = \begin{cases} \frac{(\bar{z})^2}{z}; & z \neq 0 \\ 0; & z = 0 \end{cases}$$

Satisfies Cauchy-Riemann equations at the origin but $f'(0)$ does not exist.

(d) Show that $u(x,y) = \frac{1}{2} log(x^2 + y^2)$ is harmonic in some domain. Find an analytic function $f(z)$ of which $u(x,y)$ is the real part. Also express in terms of z. **(10)**

2. (a) Find the principle value of $\left[\frac{e}{2}\left(-1 - \sqrt{3}i\right)\right]^{3\pi i}$ **(10)**

(b) Solve the equation sinz = cosh4 by equating the real and imaginary parts in the equation. **(12)**

(c) Evaluate $\int_C |z|^2 dz$, where C is the rectangle with vertices at the points 2, 8, 8 + 4i, 2 + 4i taken counterclockwise. **(13)**

3. (a) Show that $\int_C (z - z_0)^n dz = \begin{cases} 2\pi i\ ; & n = -1 \\ 0\ ; & n \neq -1 \end{cases}$ where C in any positively oriented simple closed contour and z_0 is a point within the contour, n being an integer (positive, negative and zero). **(10)**

(b) Expand $f(z) = \frac{z+1}{z-2}$ in a Taylor series in powers of z and state the region where the expansion is valid. **(7)**

(c) Find two Laurent series of the function $f(z) = \frac{1}{(z+1)(z+3)}$ valid in the regions

(i) $1 < |z| < 3$, (ii) $0 < |z+1| < 2$. **(18)**

Contd P/2

MATH 115

4. (a) Use appropriate theorem and Cauchy's integral formula to evaluate $\int_C \frac{dz}{z^2(z-2)(z-4)}$

where C is the rectangle with vertices at $3+i,\ -1+i,\ -1-i,\ 3-i$ taken in positive sense. **(10)**

(b) Find the singular points of the function $f(z)$ defined below and state the type of singularities. Then evaluate $\int_C f(z)dz$ where C is the circle $|z|=4$, taken counterclockwise:

(i) $f(z)=\frac{3z^3+2}{(z-1)(z^2+9)}$ **(9)**

(ii) $f(z)=\left(\frac{z}{2z+1}\right)^3$ **(8)**

(iii) $f(z)=\frac{\sinh z}{z^4}$ **(8)**

SECTION – B

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

5. (a) Find the equation of the tangent plane and normal line to the surface $xyz = 4$ at point $(1, 2, 2)$. **(12)**

(b) A particle moves along the curve $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$, where t is the time. Find the components of its velocity and acceleration at time $t = 1$ in the direction $\underline{i}-3\underline{j}+2\underline{k}$ **(12)**

(c) In what direction the directional derivative of $\phi = x^2y^2z$ from (1, 1, 2) will be maximum and what is its magnitude? Also find a unit normal vector to the surface $x^2y^2z = 2$ at the point (1, 1, 2). **(11)**

6. (a) Determine the constants a, b, c that the vector $\underline{F}=(x+2y+az)\underline{i}+(bx-3y-z)\underline{j}+(4x+cy+2z)\underline{k}$ is irrotational. **(12)**

(b) Show that $\bar{\nabla}\times(\bar{\nabla}\times\underline{F})=\bar{\nabla}(\bar{\nabla}\cdot\underline{F})-\bar{\nabla}^2\underline{F}$. **(12)**

(c) Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$. **(11)**

7. (a) If $\underline{F} = (2x + y)\underline{i} + (3y - x)\underline{j}$, evaluate $\int_C \underline{F}.d\underline{r}$ where C is the curve in the xy-plane consisting at the straight line from (0, 0) to (2, 0) and then to (3, 2). **(15)**

(b) Evaluate $\iint_S \underline{F}.\hat{n}\, ds$ *where* $\underline{F}=4xz\underline{i}-y^2\underline{j}+yz\underline{k}$ and S is the surface of the cube bounded by the planes, $x=0,\ x=1,\ y=0,\ y=1,\ z=0,\ z=1$. **(20)**

8. (a) Use Green's theorem in the plane to evaluate $\oint_C[(3x^2-8y^2)\,dx(4y-6xy)\,dy]$ where C is the boundary of the region defined by $x=y=0$, and $x=1-y$. **(17)**

(b) State Stoke's theorem. Verify Stoke's theorem for $\underline{F}=(x^2+y^2)\underline{i}-2xy\underline{j}$ taken round the rectangle bounded by $x=\pm a,\ y=0,\ y=b$. **(18)**

L-1/T-2/BME **Date : 26/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **PHY 167** (Electricity and Magnetism, Modern Physics, 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) What do you mean by stationary states? Using time dependent Schrödinger equation derive an expression for stationary state. **(12)**

   (b) Consider that a particle having mass m is confined inside a one-dimensional potential well with width d defined by **(15)**

$$v(x) = \begin{cases} 0 & if \quad 0 \le x \le d \\ \infty & otherwise \end{cases}$$

   Solve the Schrödinger equation for the particle to obtain an expression for the wave function. Write down the expression for first few excited states and plot them.

   (c) Show that the wave functions are mutually orthonormal for a particle confined in an infinite square well. **(8)**

2. (a) What do you mean by wave function? Write down the properties of wave function. **(7)**

   (b) Define Quantum mechanical operator. Derive an expression for the momentum operator. **(13)**

   (c) A particle of mass m is in the state $\Psi(x,t) = Ae^{-a\left[\frac{mx^2}{\hbar} + it\right]}$ **(15)**

   where A and a are constants

   (i) Find out the value of A.

   (ii) Calculate the expectation value of $\hat{x}$ and $\hat{p}$.

3. (a) State and explain Keplar's laws of planetary motion. **(7)**

   (b) Consider that the earth is revolving round the sun in a two dimensional plane. Show that the area sweeps by the radius vector drawn from the sun to earth during the 1st week of the year is equal to that of the 13th week of the year. **(20)**

   (c) The planet Mercury takes 0.24 sidereal years to go around the sun. What is the distance from the Mercury to the center of the sun? (A sidereal year is the time taken for the earth to orbit the sun). **(8)**

Contd P/2

PHY 167(BME)

4. (a) What are the failures of classical wave theory of light to explain photo-electric effect? **(5)**

(b) Show that the change in wavelength of a photon during Compton scattering is independent of the wavelength of the incident photon. **(18)**

(c) If the maximum kinetic energy given to an electron in Compton scattering experiment is 25 keV, what is the wavelength of the incident photon? **(12)**

SECTION – B

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

5. (a) Describe briefly the shell model of the nucleus. **(12)**

(b) Show that the average life time of the radioactive nucleus of a radioactive substance is proportional to the half life of that radioactive substance. **(14)**

(c) Find the average life time of the radionuclide cobalt (^{55}Co). Given, it decreases 4% per hour. The decay product is non-radioactive. **(9)**

6. (a) Show that two events appear simultaneous to an observer 'A' will not be simultaneous to another observer 'B' which is moving with respect to A. **(12)**

(b) Derive an expression for the relativistic addition of velocities. **(13)**

(c) Calculate the velocity of an object at which its kinetic energy will be twice of its rest mass energy. **(10)**

7. (a) What is a capacitor? Calculate the capacitance of a spherical capacitor. **(10)**

(b) Derive an expression and show graphically for the growth of charge and current in a RC circuit for a constant emf. **(15)**

(c) A 25 μF capacitor is connected through a 300 ohm resistor to 50 V battery. **(10)**

(i) What is the time constant of the circuit?

(ii) What is the final charge q_0 on a capacitor plate?

(iii) How long does it take for the charge on a capacitor plate to reach 0.75 q_0?

8. (a) What do you understand by magnetic force on a charged particle? Obtain an expression for the torque acting on a current carrying coil placed in a magnetic field. **(15)**

(b) Derive an expression for the force between two parallel current carrying conductors. Under what condition the force becomes attractive or repulsive? **(10)**

(c) A coil having an area of 5 cm^2 and 500 turns carries a current of 50 μA.

(i) What is the magnetic dipole moment of the coil?

(ii) The magnetic dipole moment of the coil is lined with an external field whose strength is 0.5 T. How much work would be done by an external agent to rotate the coil through 180°? **(10)**

L-1/T-2/BME **Date : 31/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **EEE 171** (Electrical Circuits)

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)**

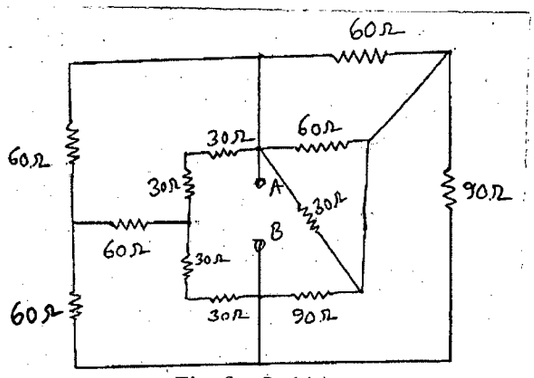

Fig. for Q. 1(a)

(b) For the circuit shown in Fig. for Q. 1(b), calculate the power supplied by each voltage source and current source. Is the total power supplied and absorbed by the different elements of the circuit equal? Justify your answer. **(17)**

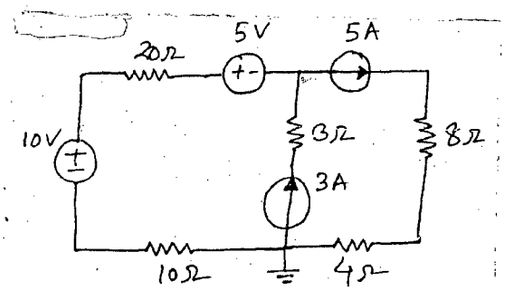

Fig. for Q. 1(b)

2. (a) Use nodal analysis to find v_0 and i_0 for the circuit shown in Fig. for Q. 2(a). **(18)**

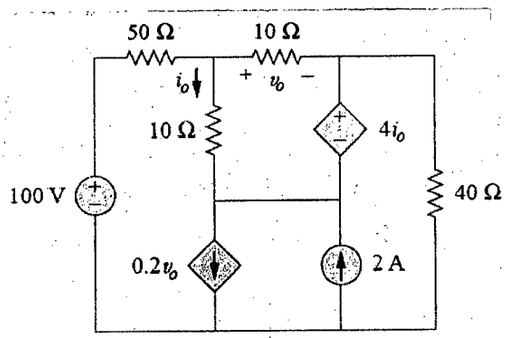

Fig. for Q. 2(a)

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EEE 171(BME)

Contd ... Q. No. 2

(b) Find current, I_0 using mesh analysis for the circuit shown in Fig. for Q. 2(b) **(17)**

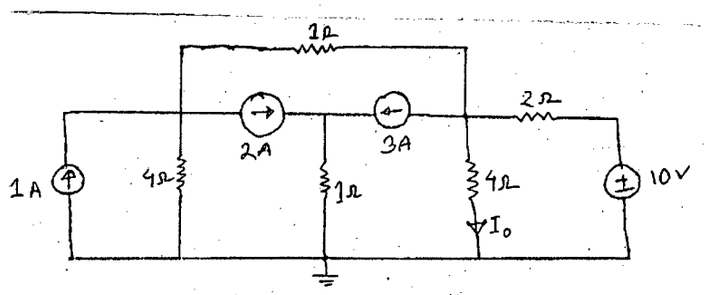


Fig. for Q. 2(b)

3. (a) Using superposition principle, determine v_0 in the circuit shown in Fig. for Q. 3(a). **(17)**

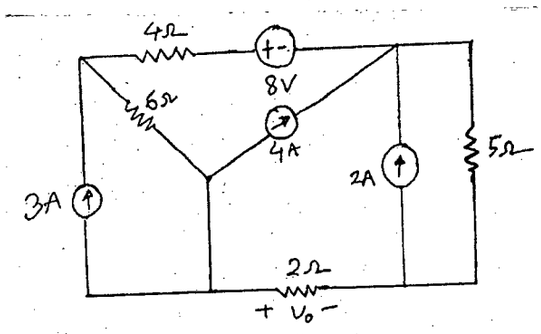


Fig. for Q. 3(a)

(b) Find the value of load, 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)**

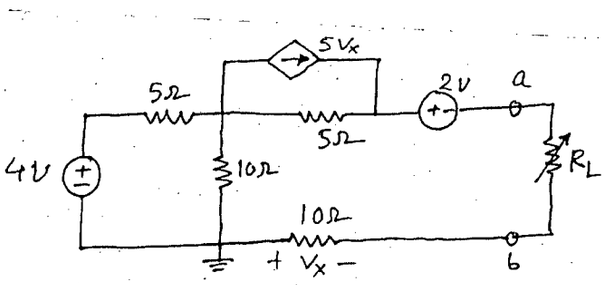


Fig. for Q. 3(b)

EEE 171(BME)

4. (a) Use Norton's theorem to find V_x in the circuit shown in Fig. for Q. 4(a). **(17)**

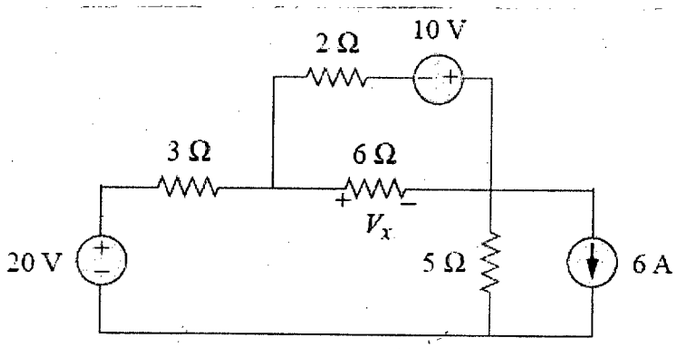


Fig. for Q. 4(a)

(b) For the magnetic circuit shown in Fig. for Q. 4(b), find the value of current, I required to establish a flux of $\Phi_1 = 1.5 \times 10^{-4}$ Wb. (Use attached B-H curve) **(18)**

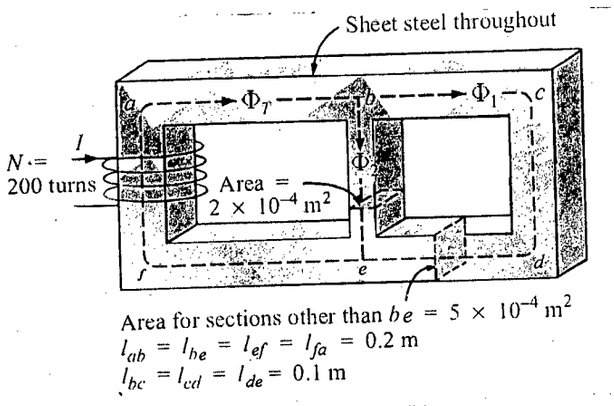


Fig. for Q. 4(b)

SECTION – B

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

5. (a) Calculate the value of Z_{ab} in the following network shown in Fig. for Q. 5(a). **(18)**

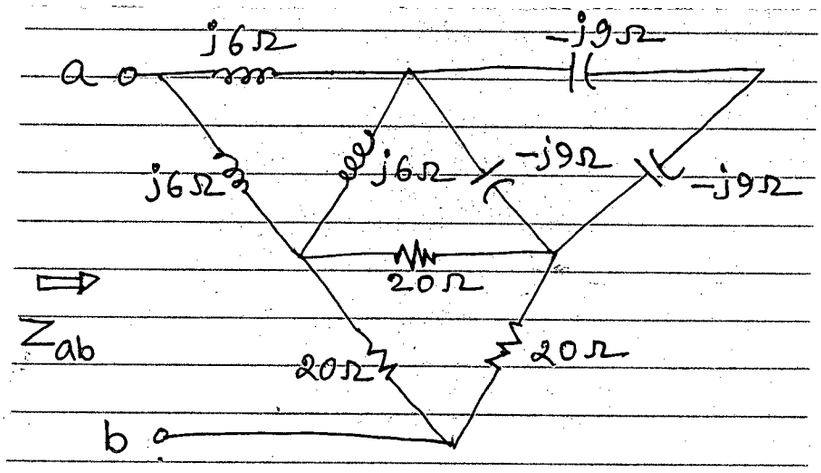


Fig. for Q.5(a)

EEE 171(BME)

Contd ... Q. No. 5

(b) Using nodal analysis, find $v_1(t)$ and $v_2(t)$ in the circuit shown in Fig. for Q. 5(b). **(17)**

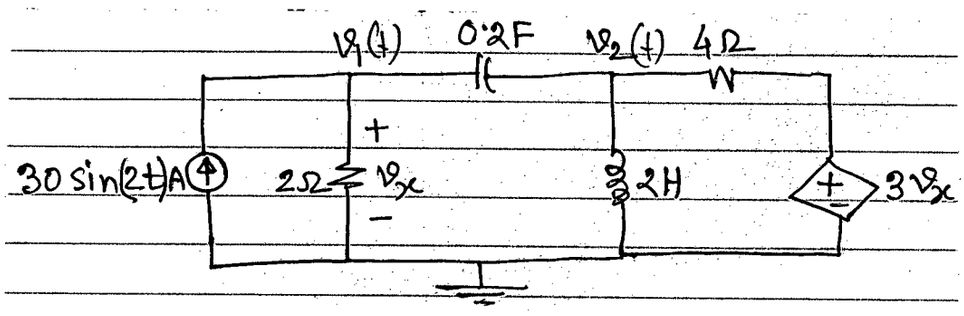


Fig. for Q. 5(b)

6. (a) Find v_0 of the circuit shown in Fig. for Q. 6(a) using superposition theorem. **(18)**

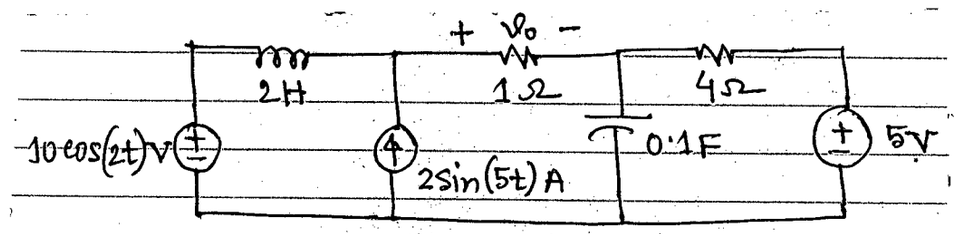


Fig. for Q. 6(a)

(b) Find the thevenin equivalent circuit at terminals a-b in the circuit shown in Fig. for Q. 6(b). **(17)**

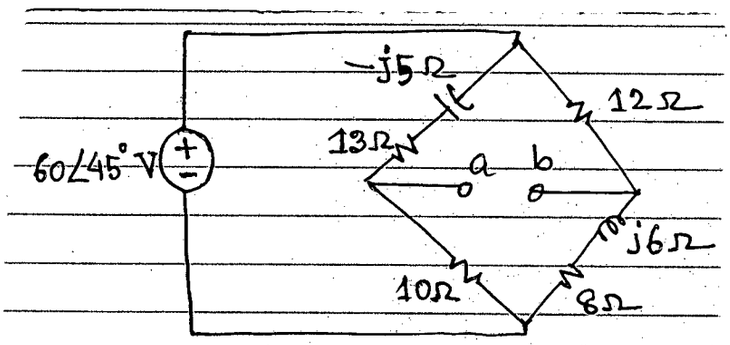


Fig. for Q. 6(b)

EEE 171(BME)

7. (a) Assume that the two balanced loads in Fig. for Q. 7(a) are supplied by an 840-V rms 60-Hz line. Load 1 is Y-connected with 30 + j 40 Ω per phase, while load 2 is a balanced three-phase motor drawing 48 kW at a power factor of 0.8 lagging. Assuming the abc sequence, calculate (i) the complex power absorbed by the combined load, (ii) the kVAR rating of each of the three capacitors Δ-connected in parallel with the load to raise the power factor to unity, and (iii) the current drawn from the supply at unity power factor condition. **(20)**

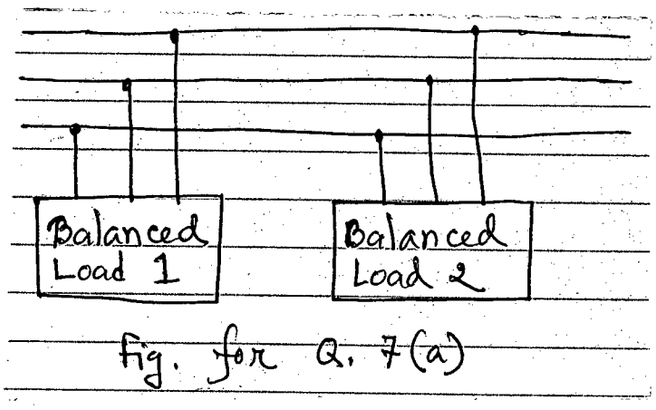


Fig. for Q. 7(a)

(b) In the balanced three-phase Y-Δ system shown in Fig. for Q. 7(b), find the line current I_L and the average power delivered to the load. **(15)**

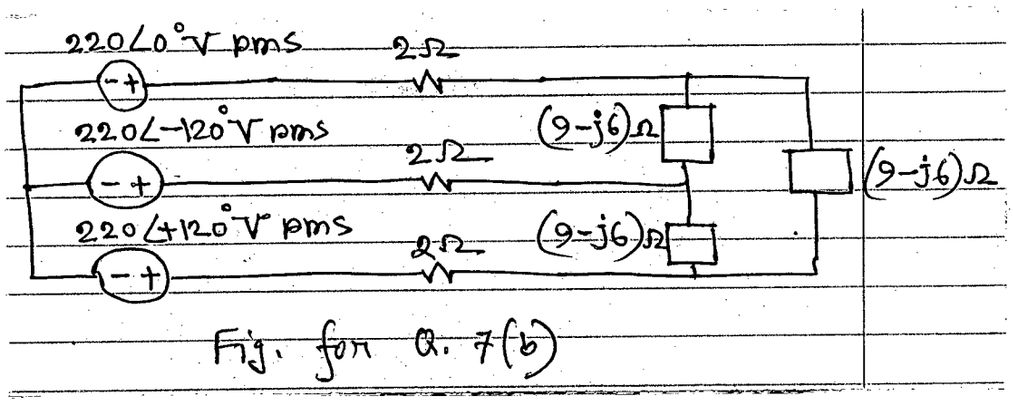


Fig. for Q. 7(b)

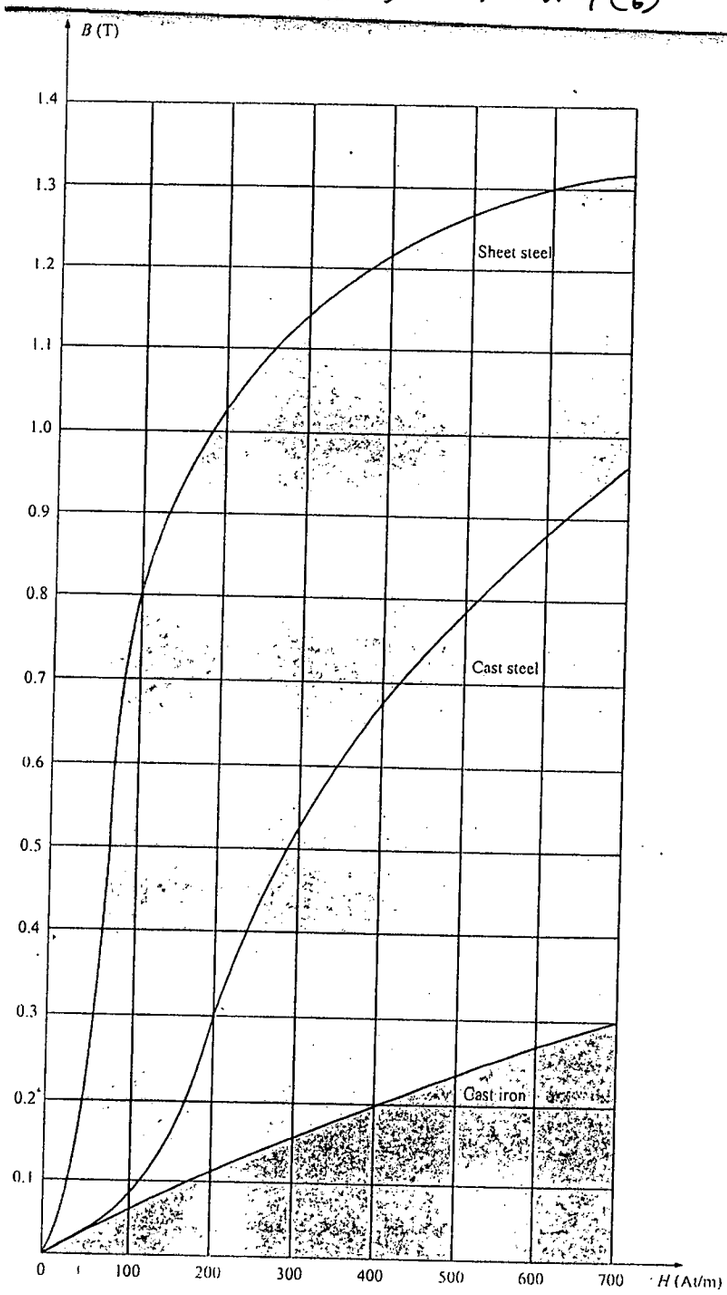
8. (a) What are the differences between ideal and real transformer? Briefly describe the basic operating principle of transformer with equivalent circuit diagrams. **(15)**

(b) Data from short-circuit and open-circuit tests of a 25-kVA, 6900 – 230 V, 60 Hz transformer are:

Open-Circuit Test	Short-Circuit Test
V_{oc} = 230 V	V_{sc} = 513 V
I_{oc} = 5.4 A	I_{sc} = 3.6 A
P_{oc} = 260 W	P_{sc} = 465 W

Determine (i) the magnetizing reactance and equivalent core-loss resistance (ii) the per unit resistance, per-unit reactance and per-unit impedance of the transformer windings; (iii) the voltage regulation when operating at rated load and 0.75 power-factor lagging. **(20)**

B-H curve for Q. No. 4(b)



L-1/T-2/MME **Date : 31/01/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **PHY 157** (Properties of Matter, Electricity and Magnetism and Modern Physics)

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) State and explain the postulates of Einstein's special theory of relativity. **(8)**

   (b) Starting from Lorentz transformation equations for space and time, derive equations for transformation of velocities. Hence show that a material particle cannot move faster than light. **(12)**

   (c) What do you mean by simultaneity? With a suitable example show that simultaneity is a relative concept. **(7)**

   (d) A clock in a spaceship emits signals at intervals of 1 second as observed by an astronaut in the spaceship. If the spaceship travels with a speed of 3×10^7 ms^{-1}, what is the interval between successive signals as seen by an observer at the control center on the ground? **(8)**

2. (a) Discuss the wave particle duality of light. **(8)**

   (b) Show that the change in wavelength of an x-ray photon striking an electron at rest in the laboratory coordinate system is given by

   $$\lambda' - \lambda = \frac{h}{m_0 c}(1 - \cos\varphi)$$

   where the symbols have their usual meaning. What is Compton wavelength? When do the Compton wavelength goes through a maximum shift? **(19)**

   (c) An x-ray photon of wavelength 0.3Å undergoes 60° Compton scattering. Find the wavelength of the scattered photon and the kinetic energy imparted to the recoiling electron. **(8)**

3. (a) Why nuclear decay occur? What happens to the atomic number and mass number of a nucleus when it (i) emits an alpha particle (ii) emits an electron (iii) emits a positron? **(9)**

   (b) What is mean life of a radioactive element? Obtain an expression for the mean life of a radioactive substance. **(10)**

   (c) Distinguish between nuclear fission and fusion. **(8)**

   (d) The alpha decay of ^{222}Rn to ^{218}Po has a half-life of 3.8 day. Find the activity in Curi of 1.00 mg of radon. **(8)**

Contd P/2

PHY 157(MME)

4. (a) What do you mean by brittleness of a material? Mention some examples of intensive and extensive properties of a matter. **(10)**

(b) Write down the equation of continuity mentioning all of its terms. Derive Bernoulli's equation for steady flow of liquid flowing through a slanted pipe. **(18)**

(c) In a horizontal oil pipeline of uniform area of cross-section, the pressure falls by 5 N/m^2 between two points separated by a distance of 1 km. What is the change in kinetic energy per kg of oil flowing at these points? Given that density of oil = 800 kg/m^3. **(7)**

SECTION – B

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

5. (a) What do you mean by a cantilever? What is elastic fatigue? **(10)**

(b) With detailed calculation, show that the twisting couples per unit twist for a hollow cylinder is greater than that for a solid cylinder having same material, mass and length. **(18)**

(c) Calculate the factor of safety in case of a piston rod of 0.2 m diameter, the maximum tensile pull on which, under working conditions is 10^6 N, and the tensile strength for the material of which is 600×10^6 N/m^2. **(7)**

6. (a) In case of stretching a wire, prove that the product of stress and strain is double of its work-done per unit volume. **(10)**

(b) How can you determine the coefficient of viscosity of a liquid using Poiseullie's method? Discuss in details. **(18)**

(c) Determine the radius of the drop of water falling through air, if the terminal velocity of the drop is 1.2 cm/sec. Assume the coefficient of viscosity of air is 1.8×10^{-4} poise and the density of air is 1.21×10^{-3} gm/cc. **(7)**

7. (a) Define electric field strength, electric potential and electric potential energy. **(6)**

(b) Calculate the electric potential at a point in an electric field due to a point charge and due to a charged ring. **(19)**

(c) A hollow metal sphere is charge with 0.4 μc and has a radius of 0.1 m. Find the potential (i) at the surface (ii) inside the sphere (iii) at a distance of 60 cm from the centre. **(10)**

8. (a) State and explain Faraday's law of electromagnetic induction. Show that for self-inductance, $L = \frac{\varepsilon}{di/dt}$ where the symbols have their usual meaning. **(10)**

(b) Obtain an expression for the growth and decay of current in a LR circuit. What is time constant of the circuit? **(15)**

(c) A coil of 1000 turns has an inductance of 20 mH. Find (i) the flux produced in the core when a current of 5 A flows in the coil and (ii) the value of the self-induced emf in the coil when the current is changed from +5A to –5A in 20 ms. **(10)**

L-1/T-2/BME **Date : 06/02/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2015-2016

Sub : **CHEM 127** (Physical Chemistry)

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) The quantitative relation between the volume of an ideal gas with temperature at a constant pressure introduced a new unit of temperature – Justify the statement. **(6)**

(b) In the following Van der Waal's equation. **(8)**

$$\left(p+\frac{n^2a}{V^2}\right)(V-nb)=nRT$$

write down the significance of a and b.

(c) Draw a typical curve for the distribution of molecular velocities for gas according to Maxwell and Boltzmann at three different temperatures of T_1, T_2 and T_3, where $T_1 > T_2 >. T_3$. Explain the nature of the curves for different temperature you have drawn. **(7)**

(d) The equation for the metabolic breakdown of glucose ($C_6H_{12}O_6$) is the same as the equation for the combustion of glucose in air.

$$C_6H_{12}O_6\,(s) + 6O_2(g) \rightarrow 6\,CO_2\,(g) + 6H_2O(l)$$

Calculate the volume of CO_2 produced at 37°C and 1.00 atm when 5.60 g of glucose is used up in the reaction. **(6)**

(e) a 12.5 L scuba diving tank contains a helium-oxygen (heliox) mixture made up of 24.2 g of He and 4.32 g of O_2 at 298 k. Calculate the mole fraction and partial pressure of each component in the mixture and the total pressure of the mixture. **(8)**

2. (a) How the solubility of oxygen in water as a function of temperature is related with ecological imbalance. **(7)**

(b) The heat of solution of succinic acid in water can be determined from the solubility measurements at different temperatures. Write down the principle of such measurement. **(8)**

(c) For the solution obeying Raoult's law show that the vapor is always richer with more volatile component. **(8)**

(d) What is partition coefficient? Write down some applications of the partition coefficient. **(4)**

(e) A nurse needs 525 g of 2.00% sterile saline solution (NaCl). She has two sterile stock solution of NaCl: 5.000% and 0.500% by mass, but no sterile water. How can she make the required solution? **(8)**

Contd P/2

CHEM 127(BME)

3. (a) Ethylene glycol is antifreezer used to lower the freezing point of water. **(2+10=12)**

   (i) define freezing point of solution.

   (ii) Prove that the freezing point depression due to the addition of ethylene glycol to water is independent of the nature of ethylene glycol.

   (b) Principle of osmosis can be applied for the desalination of water. Explain the principle. **(8)**

   (c) Write down two examples of osmosis in biological system. **(6)**

   (d) Nicotine, extracted from tobacco leaves, is a liquid completely miscible with water at temperature below 60°C (i) What is the molality of nicotine in an aqueous solution that starts to freeze at – 0.450 °C? **(9)**

   (ii) If this solution is obtained by dissolving 1.921 g of nicotine in 48.92 H_2O, what must be the molar mass of nicotine? [k_f of water = 1.86 °C m^{-1}].

4. (a) What are the scopes of Chemical Kinetics? **(4)**

   (b) Derive the integrated rate expression of the following reaction and answer the followings **(6+3+3=14)**

   $$A \rightarrow \text{Product}$$

   (i) Show that half life of the reaction is independent of initial concentration.

   (ii) The reaction will never be completed.

   (iii) What is the unit of rate constant?

   (e) What are the main assumptions of Collision theory of reaction Kinetics? With the help of the theory explain that q fourth or higher order reaction is improbable. **(6+3=9)**

   (d) The decomposition of hydroxylamine (NH_2OH) in the presence of oxygen follows the rate law

   $$\frac{-d[NH_2OH]}{dt} = K_{obs}[NH_2OH][O_2]$$

   where K_{obs} is 0.237×10^{-4} $Lmol^{-1}$ s^{-1} at 0°C and 2.64×10^{-4} $Lmol^{-1}$ s^{-1} at 25°C. Calculate activation energy and preexponential factor for the reaction. **(8)**

SECTION – B

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

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

5. (a) Define entropy. Derive an expression for entropy change accompanying isothermal expansion of an ideal gas. **(12)**

   (b) Explain the term free energy. Establish the relationship dG = VdP – SdT and hence derive an expression for change in free energy for an isothermal process. **(13)**

Contd P/3

CHEM 127(BME)

Contd ... Q. No. 5

(c) Calculate the free energy change accompanying the compression of 44 g CO_2 at 57°C from 5 atm to 50 atm. Assume CO_2 behaves like an ideal gas and comment on the result. **(10)**

6. (a) Define the following terms: **(12)**

   (i) Heat of formation

   (ii) Heat of neutralization

   (iii) Differential and integral heat of solution.

   (b) What are reversible and irreversible cells? Explain how Gibbs-Helmholtz equation can be used to calculate the enthalpy change of a reaction occurring in a reversible cell. **(13)**

   (c) At 25°C the value of the emf for the reversible cell

   $$Pb, PbCl_2 (s) \mid KCl (aq) \mid AgCl (s), Ag$$

   is 0.4902 volt and $(\partial E/\partial T)_p = -1.86 \times 10^{-4}$ Volt deg^{-1}. Show the half cell reaction, overall cell reaction and calculate the values of ΔG, ΔH and ΔS for the cell reaction. **(10)**

7. (a) State the 'law of mass action'. How can you use this law to derive an expression for the equilibrium constant of a reaction? Briefly explain the term 'thermodynamic equilibrium constant'. **(12)**

   (b) Deduce Van't Hoff equation for the temperature dependence of equilibrium constant. Explain how this equation provides information about exothermic and endothermic nature of chemical reactions. **(13)**

   (c) The equilibrium constant K_p for the reaction $N_2 (g) + 3H_2 (g) \rightleftharpoons 2NH_3 (g)$ is 1.64×10^{-4} at 400°C. What will be the equilibrium constant at 500°C if the heat of reaction in this temperature range is – 105185.8 J. **(10)**

8. (a) State and explain Kohlrausch's law of independent migration of ions. Discuss how you can determine the $\wedge_0$ value of NH_4OH with the help of this law. **(12)**

   (b) What is buffer capacity? Show that an acidic buffer shows maximum buffer capacity when pH = pKa. **(13)**

   (c) Calculate the pH of a solution obtained by mixing 5 g of acetic acid and 7.5 g of sodium acetic making the volume to 500 mL (given: K_a for acetic acid = 1.85×10^{-5} at 25°C) **(10)**
