L-1/T-2/BME **Date : 31/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

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

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) Find voltages V_1, V_2, V_3, and V_4 using nodal analysis for the circuit shown in Fig. for Q. 1(a). **(18)**

   (b) Find currents i_1, i_2, i_3, and i_4 using mesh current analysis for the circuit shown in Fig. for Q. 1(b). **(17)**

2. (a) Find voltage V_x using superposition method for the circuit shown in Fig. for Q. 2(a). **(18)**

   (b) Find Thevenin's equivalent circuit between terminals a-b for the circuit shown in Fig. for Q. 2(b). **(17)**

3. (a) Find Norton's equivalent circuit between terminals a-b for the circuit shown in Fig. for Q. 3(a). **(17)**

   (b) Find current I_a using Norton's theorem for the circuit shown in Fig. for Q. 3(b). **(18)**

4. (a) Find the real and reactive power delivered by the current source for the circuit shown in Fig. for Q. 4(a). **(18)**

   (b) Find load, Z_L so that maximum power will be transferred to load for the circuit shown in Fig. for Q. 4(b). What is that maximum power? **(17)**

SECTION - B

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

5. (a) Fig. for Q. 5(a) shows a ferromagnetic core whose mean path length is 40 cm. There is a small gap of 0.05 cm in the structure of the otherwise whole core. The cross sectional area of the core is 10 cm^2. Determine the current that will develop a magnetic flux of 0.65×10^{-4} Wb. **(17)**

Contd P/2

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Contd... Q. No. 5(a)

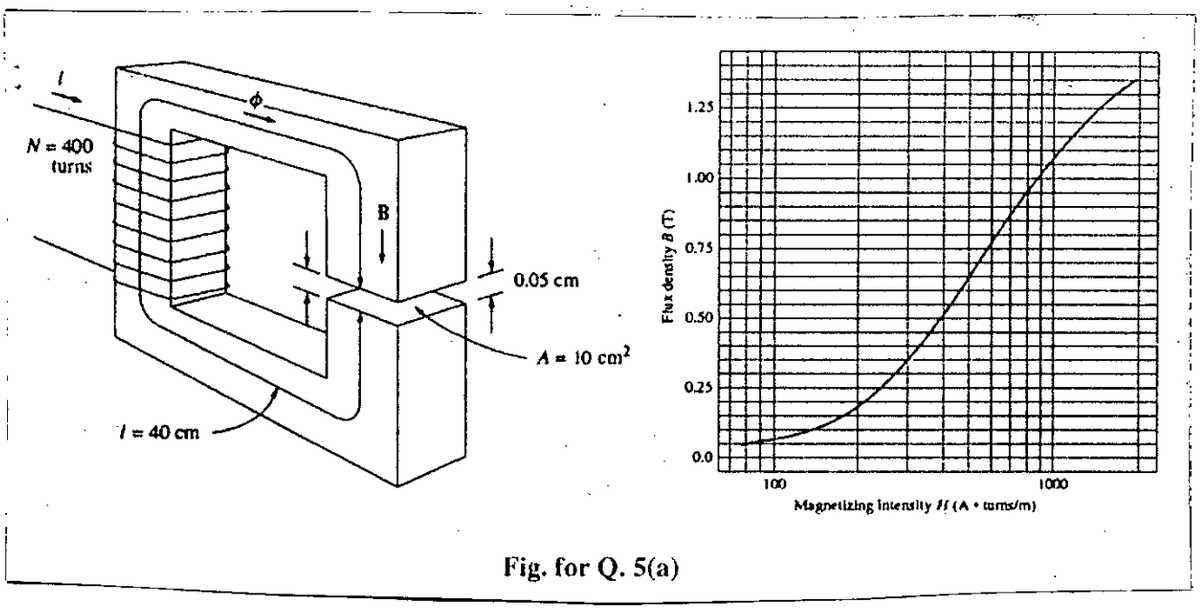

Fig. for Q. 5(a)

(b) The switch in Fig. for Q. 5(b) has been in position A for a long time. At t = 0 the switch moves to position B. Determine $v_c(t)$ for t>0 and calculate its value at t=5 s. **(18)**

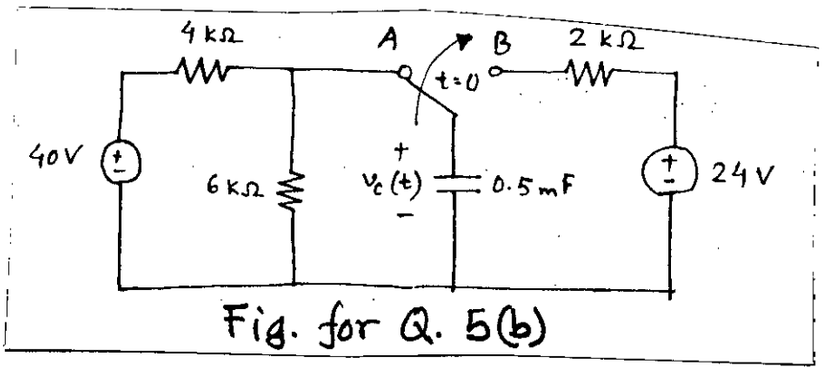

Fig. for Q. 5(b)

6. (a) A balanced Δ-connected load with impedance 9 + j 15 Ω per phase is connected to balanced 3-phase Y-connected generator (phase voltage = 230 rms) through transmission lines of 0.15 + j2.0Ω. Determine the line voltage at the sending end, line voltage at the receiving end, and also the power lost in the transmission line. **(15)**

(b) Two balanced three-phase loads are connected to 11 kV, 50 Hz line. Load- 1 draws 30 kW at a power factor of 0.6 lagging, while load-2 draws 45 kVAR at a power factor of 0.8 lagging. Determine the power factor of the combined load. Find the per-phase capacitance of Δ-connected capacitor bank that will raise the power factor 0.9 lagging. **(20)**

7. (a) Fig. for Q. 7(a) shows the current in a series RLC circuit when source frequency is varied from 0 Hz to 5 kHz. Determine the resonant frequency, bandwidth and quality factor for the circuit. If C is given as 100 nF, determine the value of R and L. **(15)**

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

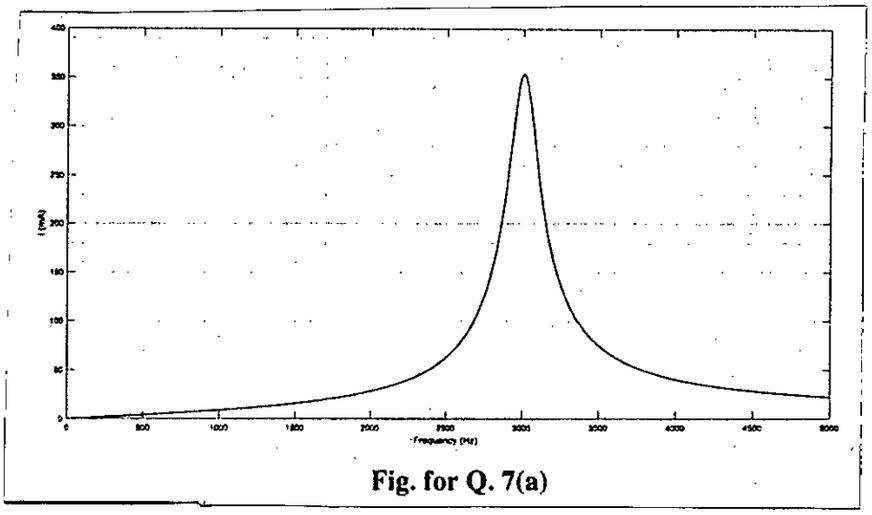

Fig. for Q. 7(a)

(b) What are the differences between an active filter and a passive filter? Draw the circuit diagram of a first-order, active, low-pass filter. Derive the transfer function of this filter and hence determine its cutoff frequency and DC gain. **(15)**

(c) Suppose you are given a low pass filter and a high pass filter. How will you combine them to form a notch filter? Explain your answer. **(5)**

8. (a) For the circuit shown in Fig. for Q. 8(a), sketch $v_o(t)$. Given that $V_3 = 3V$, $V_2 = -2V$ and V_1 is a triangular wave as shown in the Figure. **(20)**

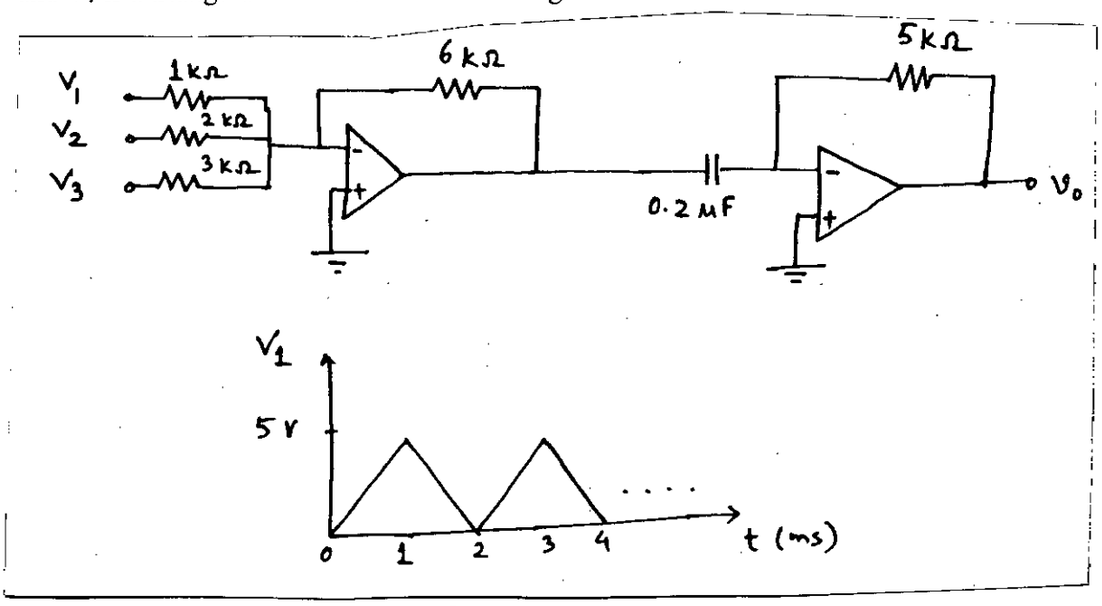

Fig. for Q. 8(a)

(b) Design a circuit using Operational Amplifiers to solve the following differential equation for t>0. **(15)**

$$3\frac{d^2v_o}{dt^2} - 2\frac{dv_o}{dt} = v_i(t)$$

Given that $v_o(0) = 2$ and $v_o'(0) = 0$.

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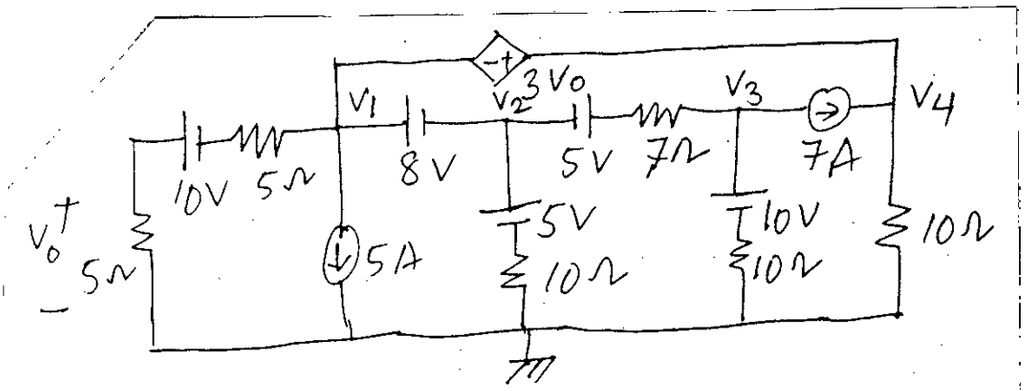

Fig. for Q1(a)

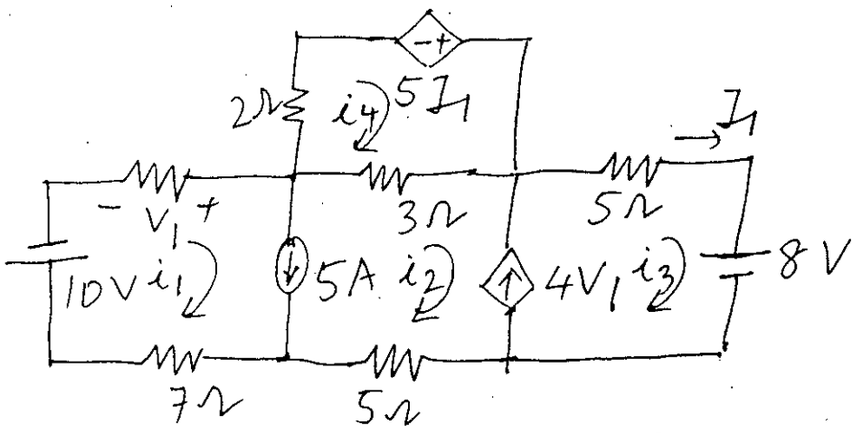

Fig. for Q1(b)

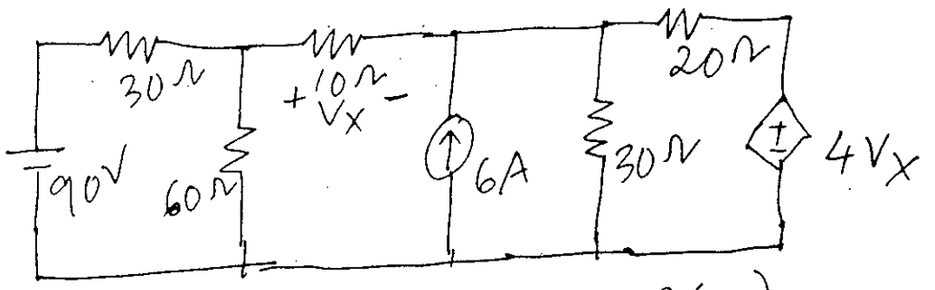

Fig. for Q2(a)

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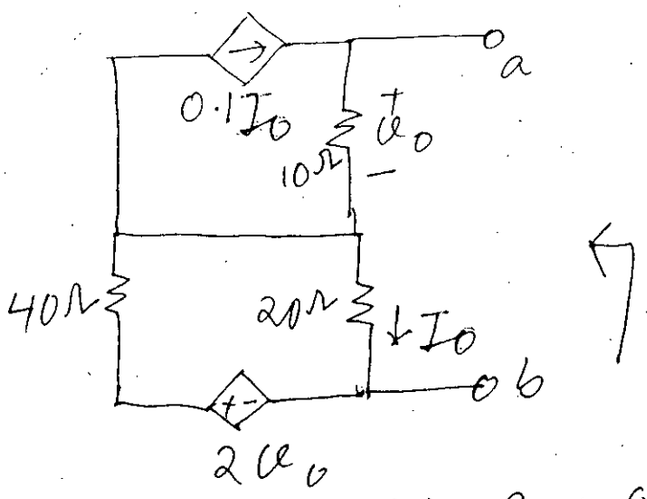

Fig. for Q2(b)

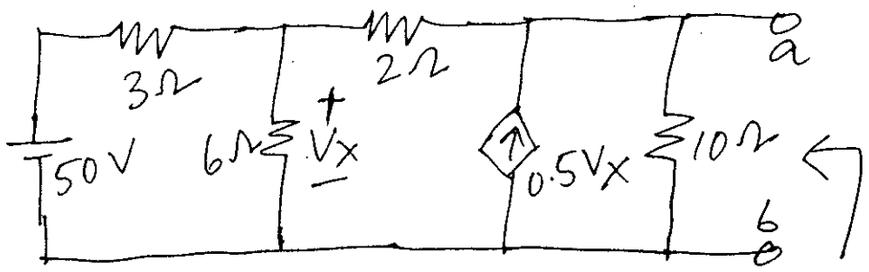

Fig. for Q3(a)

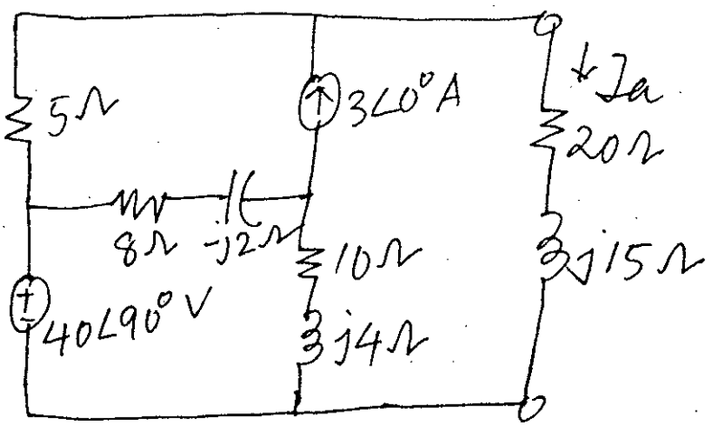

Fig. for Q3(b)

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L-1/T-2/BME **Date : 06/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **PHY 167** (Electricity and Magnetism, Modern Physics, 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) Define linear momentum of a system of particles. State the principle of the conservation of linear momentum. **(8)**

(b) (i) Show that $\vec{\tau} = \frac{d\vec{l}}{dt}$, where $\vec{\tau}$ is the torque acting on the particle and $\vec{l}$ is the angular momentum of the particle. **(17)**

(ii) Prove the work-energy theorem for rotational motion.

(c) An α-particle (the nucleus of a helium atom) is emitted from a uranium-238 nucleus, originally at rest, with a speed of 1.4×10^7 m/sec and a kinetic energy of 4.1 MeV. Find the recoil speed of the residual nucleus (thorium-234). How can you compute the kinetic energy of the recoiling nucleus? **(10)**

2. (a) Write down the physical significance of wave function. **(7)**

(b) (i) Show that $\frac{\partial \rho}{\partial t} + \vec{\nabla}.\vec{J} = 0$, where ρ is the probability density and J is the probability current density. **(20)**

(ii) Write down Schrödinger wave function for a linear harmonic oscillator and solve it to obtain ground state energy $E = \frac{1}{2}\hbar\omega_0$, where $\omega_0 = \sqrt{K/m}$.

(c) The general eigen function is given by $\psi_n(x) = A\sin\frac{n\pi x}{L}$ for a particle moving Freely in a dimensional box of length L, where the box is supposed to have walls of infinite height at x = 0 and x = L. Find the normalized wave function of the particle. (where n is quantum numbers and equals 1,2,3,...). **(8)**

3. (a) Define Hamiltonian operator. Show that the momentum operator commutes with the free particle Hamiltonian operator i.e. $[\hat{H}, \hat{P}] = 0$. **(10)**

(b) (i) What is meant by stream line motion? What is the equation of continuity? **(18)**

(ii) Discuss the various forms of energy possesses by liquid in motion. State Bernoulli's principle.

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

Contd P/2

PHY 167

4. (a) Show that Galilean Transformation equations fails to prove the principle of constancy of speed of light in special theory of relativity. **(7)**

(b) Why space and time are not considered to be absolute quantities in relativity? Explain the relativity of mass and from this derive the relativistic form of energy, $E = \sqrt{m_0^2 c^4 + p^2 c^2}$, where the symbols have their usual meaning. **(20)**

(c) Muons are elementary particles with a lifetime of 2.2 μs. They are produced with very high speed in the upper atmosphere when cosmic rays collide with air molecules. Take the height of the atmosphere to be 100 Km in the reference Frame of the earth. Find the minimum speed that enables the muons to survive the journey to the surface of the earth. **(8)**

SECTION - B

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

5. (a) Explain photoelectric-effect. In a photoelectric-effect experiment, which of the following will increase the maximum kinetic energy of the photoelectrons? (i) Use of light having greater intensity; (ii) use of light having higher frequency; (iii) use of light having longer wavelength; (iv) use of metal surface with a larger work function. In each case justify your answer. **(20)**

(b) What happens when energy of the incident radiation on a carbon surface gradually increases from 0.01 to 100 MeV? **(6)**

(c) Ultraviolet light of wavelength 350 nm and intensity 1.00 W/m^2 is directed at a sodium surface of work function 2.36 eV. (i) Find the maximum kinetic energy of the photoelectrons. (ii) If 0.5 percent of the incident photons can produce photoelectrons, what will be the amount of photocurrent from a sodium surface of area 1.00 cm^2? **(9)**

6. (a) Define average binding energy and describe the average binding energy mass curve. **(12)**

(b) Briefly explain the steps of a fission reaction. A city requires on the average 700 MW of electrical power per week and this is to be supplied by a nuclear reactor of efficiency 20%. Using U-235 as a nuclear fuel, calculate the amount of fuel required for one day's operation. Energy released per fission of U-235 nuclide is 200 MeV. **(13)**

(c) Discuss the importance of nuclear power plant in Bangladesh. Among the fission and fusion process which process is more safe and viable for power plant and why? **(10)**

Contd P/3

PHY 167

7. (a) Briefly explain quantization of charge and conservation of charge. **(5)**

(b) Consider a thin ring of radius R with a uniformly distributed charge Q around its circumference. Show that the electric field $\vec{E}$ at a distance z from the plane of the ring along its central axis is given by $E = \frac{1}{4\pi\varepsilon_0} \frac{zQ}{\left(z^2 + R^2\right)^{3/2}}$, where the terms have their usual meaning. Find the electric field when (i) $z << R$, (ii) $z >> R$ and (iii) at the centre of the ring, i.e., z = 0. **(22)**

(c) Two equally charged particles are held 3.2×10^{-3} m apart and then released from rest. The initial acceleration of the first particle is observed to be 7.0 m/s^2 and that of the second to be 9.0 m/s^2. If the mass of the first particle is 6.3×10^{-3} kg, what are (i) the mass of the second particle and (ii) the magnitude of the charge of each particle? **(8)**

8. (a) According to microscope Ohm's law show that the electric field $\vec{E}$ is given by $E = \left(\frac{m}{e^2 \pi \tau}\right) J$, where the terms have their usual meaning. **(7)**

(b) Deduce the expressions for charge and current while charging of a capacitor and show that the potential difference across the capacitor during the charging process is given by $V_C = \xi\left(1 - e^{-t/RC}\right)$, where the terms have their usual meaning. **(22)**

(c) In an RC series circuit, emf ξ = 12.0 V, resistance R = 1.40 MΩ, and capacitance C = 1.80 μF. (i) Calculate the time constant. (ii) Find the maximum charge that will appear on the capacitor during charging. **(6)**

L-1/T-2/BME Date : 10/04/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

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) What are colligative properties? Derive Raoult's law of elevation of boiling point from thermodynamic consideration. A solution of 12.5 g of an unknown solute in 170 g of water gives a boiling point elevation of 0.63 K. Calculate the molar mass of the solute. (K_b = 0.52 Km^{-1}). **(2+8+5)**

   (b) With the help of a vapour pressure-temperature curve, prove that the depression of freezing point of a solvent due to the addition of a solute is proportional to the molality of the solution. **(12)**

   (c) Explain vapour pressure theory of osmosis. At 20°C the solubility of nitrogen gas in water is 0.0150 g/L when the partial pressure on N_2 is 580 torr. Find the solubility of N_2 in H_2O at 20°C when its partial pressure is 800 torr. **(8)**

2. (a) Explain the phase diagram of water-phenol system. What is critical solution temperature? **(10)**

   (b) With the help of a boiling point-composition graph, explain the theory of fractional distillation. What is an azeotropic mixture? **(13)**

   (c) What is osmosis? State van't Hoff's law of osmotic pressure and derive the osmotic pressure equation $\pi V = nRT$. The osmotic pressure of blood at 37°C is 7.6 atm. A solution that is given intravenously must have the same osmotic pressure as blood. What should be the molarity of a glucose solution to give an osmotic pressure of 7.6 atm at 37°C? **(12)**

3. (a) Derive an equation to determine the equilibrium constant from emf measurement. A cell is composed of the Cr/Cr^{3+} electrode and the Fe/Fe^{2+} electrode. What is the free energy change for the cell? Calculate the equilibrium constant for the cell at 25°C. Given the cell emf is 0.3 V. **(10)**

   (b) What are fuel cells? Construct and explain the working principle of H_2-O_2 fuel cell. **(10)**

   (c) What is corrosion? With the help of a diagram, show the mechanism of rusting of iron. When an aqueous solution of potassium iodide is electrolysed using platinum electrodes, the half reactions are $2I^-(aq) \rightarrow I_2(aq) + 2e$ and $2H_2O(l) + 2e \rightarrow H_2(g) + 2OH^-(aq)$. How many grams of iodine are produced when a current of 8.52 mA flows through the cell for 10.0 min? **(2+8+5)**

Contd P/2

CHEM 127(BME)

4. (a) Suppose you are supplied with a solution whose pH you have to determine. With the help of a standard zinc electrode, how would you determine the pH of the solution? The voltaic cell Cd(s) | Cd^{2+} (aq) || Ni^{2+} (1.0 M) |Ni(s) has a cell potential of 0.240 V at 25°C. What is the concentration of cadmium ion? (E°cell = 0.170 V.) **(10)**

(b) Electrochemical biosensors are widely used in diagnosis of infectious diseases as well as in criminal investigations. Illustrate the construction and working principle of a DNA biosensor. **(10)**

(c) Why the real gases deviate from ideal behaviour? Explain with appropriate graphs. Deduce Charles's law and Graham's law of diffusion from the kinetic gas equation. **(9+6)**

SECTION – B

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

5. (a) What is the effect of common ion on solubility Equilibria? Justify your answer with proper example. **(7)**

(b) Describe different types of salts depending on the behaviour towards hydrolysis. **(7)**

(c) Calculate the pH, degree of dissociation and concentration of various species in a solution of 0.1 M acetic acid which also contains 0.1 M sodium acetate (K_a for acetic acid) = 1.85×10^{-5} $moldm^{-3}$). **(9)**

(d) Establish the equation to calculate the change in free energy of a reaction in the standard form from the equilibrium constant. **(12)**

6. (a) Describe the different methods to determine the order of a reaction. **(12)**

(b) Explain briefly the Collision theory of reaction rates. What are its limitations and how far they are overcome by theory of absolute rates? **(8)**

(c) Consider the reaction **(7)**

$$4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g)$$

During the reaction, molecular Oxygen is reacting at the rate of 0.024 M/S.

(i) At what rate is N_2O_5 being formed? (ii) At what rate NO_2 is reacting?

(d) What is steady-state hypothesis? Show how the concentration of reactants and products in a consecutive reaction will change with respect to time. **(8)**

7. (a) State Hess's law of constant heat summation and explain some of its important applications. **(7)**

(b) The heat of reaction $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl$ at 27°C is – 22.1 Kcal. Calculate the heat of reaction at 77°C. The molar heat capacities at constant pressure at 27°C for hydrogen, chlorine and HCl are 6.82, 7.70 and 6.80 $calmol^{-1}$ respectively. **(7)**

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CHEM 127(BME)
Contd...Q. No. 7

(c) Define the following terms: **(10)**
(i) Bond Energy, (ii) Internal Energy, (iii) Heat of vaporisation (iv) Collision frequency (v) Rate constant.

(d) State the three laws of thermodynamics with their mathematical form. **(9)**

(e) Write about the Joule-Thomson Effect. **(2)**

8. (a) Calculate the Net heat absorbed in one cycle and thermodynamic efficiency of the Carnot cycle. **(8)**

(b) What are the Intensive and Extensive properties of a system? Derive Gibbs Phase rule from thermodynamic considerations. **(7)**

(c) Draw and explain a typical Phase diagram of a one component system. **(12)**

(d) How many Phases are present if a drop of water placed in a stoppered bottle? Explain the following terms-(i) Metastable equilibrium (ii) Invariant system (iii) Eutectic point. **(8)**

L-1/T-2/BME **Date : 25/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

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

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks. The questions are equal value.

SECTION – A

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

1. (a) Show that the function **(11)**

$$f(z)=\frac{x^3(1+i)-y^3(1-i)}{x^2+y^2}, \quad z\neq 0$$
$$=0, \qquad\qquad z=0$$

satisfies the Cauchy-Riemann equations at z = 0. Is the function analytic at z = 0?

(b) Describe locus of points z that satisfy **(12)**

(i) $|z+2-3i|+|z-2+3i|<10$

(ii) $\mathrm{Re}(z^2)>1$

(c) Prove that $u=x^2-y^2-2xy-2x+3y$ is harmonic. Find a function v such that $f(z)=u+iv$ is analytic. Also express $f(z)$ in terms of z. **(12)**

2. (a) Separate $\sqrt{i}^{\sqrt{i}}$ into real and imaginary parts. **(11)**

(b) Find all roots of $\left(-8-8\sqrt{3}\,i\right)^{1/4}$ is Cartesian coordinates and show distinct roots geometrically. **(12)**

(c) Evaluate $\int_0^{2+i}(\bar{z})^2\,dz$ along the real axis from $z=0$ to $z=2$ and then along a line parallel to y-axis from $z=2$ to $z=2+i$. **(12)**

3. (a) State Cauchy integral formula and use it to evaluate $\oint_C \frac{4-3z}{z(z-1)(z-2)}\,dz$, where C is the circle $|z|=\frac{3}{2}$. **(15)**

(b) Express $f(z)=\frac{1}{(z+1)(z+3)}$ in a Laurent series valid in the region **(20)**

(i) $0<|z+1|<2$ (ii) $1<|z|\leq 3$ (iii) $|z|>3$

4. (a) Define the singularity of a function. Find the singularities of the following functions and determine their nature: **(18)**

(i) $f(z)=\frac{e^{\frac{1}{z}}}{z^2}$ (ii) $f(z)=\frac{1}{1-e^z}$ (iii) $f(z)=\frac{\sin(z-a)}{z-a}$

(b) Evaluate the integral $\oint_C \frac{e^{zt}}{z^2(z^2+2z+2)}\,dz$ by Cauchy residue theorem, where C is the circle $|z|=3$. **(17)**

Contd P/2

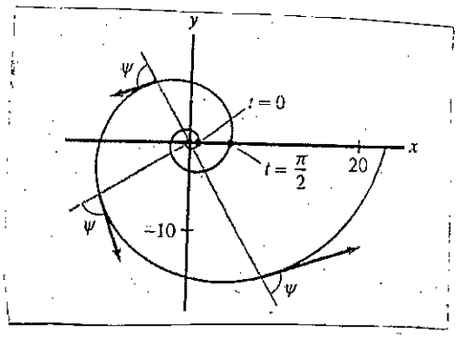
MATH 115

SECTION - B

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

5. (a) Sketch the space curve $x = 3\cos t,\ y = 3\sin t,\ z = 4t$ and find (i) unit tangent, (ii) the principal normal and (iii) the binormal. **(10)**

(b) The Bernoulli spiral (see following figure) with space curve $\vec{r}(t) = \left(e^t \cos 4t, e^t \sin 4t\right)$ has the property that the angle ψ between the position vector and the tangent vector is constant. Find the angle ψ in degrees. **(15)**



(c) Find the value of α such that the curvature of $y = e^{\alpha x}$ at $x = 0$ is as large as possible. **(10)**

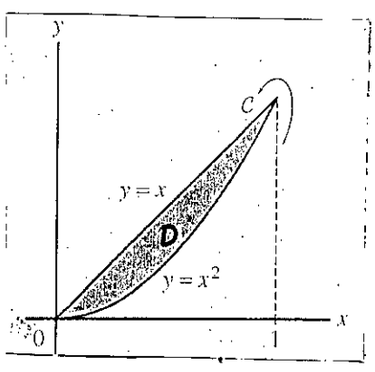
6. (a) A bug located at (3, 9, 4) begins walking in a straight line toward (5,7, 3). At what rate is the bug's temperature changing if the temperature is $T(x, y, z) = xe^{y-z}$? Given that units are in meters and degrees in Celsius. **(10)**

(b) Find the values of the constants a, b, c so that the directional derivative of $\varphi = axy^2 + byz + cz^2x^3$ at (1,2,-1) has a maximum of magnitude 64 in a direction parallel to the z-axis. **(12)**

(c) Show that the vector field $\vec{v} = \dfrac{-x\hat{i} - y\hat{j}}{\sqrt{x^2 + y^2}}$ is a sink field. **(13)**

7. (a) Prove that $\vec{F} = \left(y^2 \cos x + z^3\right)\hat{i} + \left(2y \sin x - 4\right)\hat{j} + \left(3xz^2 + 2\right)\hat{k}$ is a conservative force field. Then find the scalar potential for $\vec{F}$. **(15)**

(b) Find total work done for $\vec{F} = (x + y)\hat{i} + \left(x^2 - y\right)\hat{j}$ which moves a particle along the path *C*. **(10)**



Contd P/3

MATH 115

Contd... Q. No. 7

(c) Prove that $\iiint_V \vec{\nabla} \times \vec{B}\, dV = \iint_S \hat{n} \times \vec{B}\, dS$, where $\hat{n}$ is the unit normal to the surface S where V is the volume bounded by the closed surface S. **(10)**

8. (a) Given the vector field $\vec{G} = 16xy\,\hat{i} + 12y\,\hat{j} + (z^2 - xy)\hat{k}$ use Gauss divergence theorem to find the net flux of $\vec{G}$ over the cube $0 < x, y, z < 1$. **(15)**

(b) Consider the vector field $\vec{F} = (x - z)\hat{i} + (y - x)\hat{j} + (z - xy)\hat{k}$. Use Stokes theorem to find the circulation around the triangle with vertices $A(1,0,0)$, $B,(0,2,0)$, and $C(0,0,1)$ oriented counterclockwise looking from the origin toward the first octant. **(20)**

L-1/T-2/BME

Date : 14/03/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2017-2018

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

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) What is the most important concept of fluid-mosaic model? What type of cell movement is involved in the tissue phagocytosis process? **(10+5)**

   (b) What are the differences between rough and smooth endoplasmic reticulum? Write the functions of smooth endoplasmic reticulum. **(12)**

   (c) Compare different types of cytoskeleton in tabular form. **(8)**

2. (a) Name the organic and inorganic components of bone. What will be the expected change in bone's mechanical property due to burn? Explain. **(13)**

   (b) What are the differences between cartilage and bone? **(8)**

   (c) Which one is the most movable joint in the body? With example, mention different types of that joint. **(14)**

3. (a) Mention the location of different heart valves. With a schematic diagram, show the location of best auscultation of different heart valves. **(13)**

   (b) What is the name of the membrane that separates the outer ear from the middle ear? What is the function of it? **(7)**

   (c) Write short notes on (any three) **(5×3=15)**

   (i) Congenital anomalies of Heart, (ii) Branches of left coronary artery, (iii) Coronary predominance and (iv) Conducting tissue of heart.

4. (a) Briefly explain the respiratory movements and their mechanism. **(12)**

   (b) What are pleura? Write the functions of nose. **(10)**

   (c) What are the differences between right and left principal bronchus? **(8)**

   (d) Write the functions of micro filaments. **(5)**

Contd P/2

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SECTION - B

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

5. (a) Describe the characteristic features of antigravity muscles of trunk. **(10)**

   (b) What do you mean by swing and shunt components of a skeletal muscle? **(6+6=12)**

   (c) How does connective tissue cover muscles? Mention the importance of these coverings. **(5+8=13)**

6. (a) Classify nervous system. Write about the functions of frontal lobe of cerebrum. **(6+6=12)**

   (b) Explain how spinal cord is kept in position. Name the structures through which light passes from outer coat to inner coat of eyeball. **(5+5=10)**

   (c) Describe the parts and functions of a nephron. Write about the constrictions of ureter with importance. **(7+6=13)**

7. (a) Mention in a tabulated form the location and secretions of endocrine glands of the body. **(12)**

   (b) Write the contents of (i) Cranial cavity, (ii) Middle mediastinum. **(5×2=10)**

   (c) Explain why range of movement is more but strength is less in parallel arrangement of skeletal muscle fibres. Show in a schematic diagram the components of pennate muscle. **(3+5=8)**

   (d) What are the characteristic features of cardiac muscle? **(5)**

8. (a) Describe the parts of extrahepatic biliary apparatus with a neat diagram. **(10)**

   (b) Differentiate between small intestine and large intestine. Explain how skin protects our body. **(5+5=10)**

   (c) Write about the parts and functions of fallopian tubes. Name the parts of male reproductive system. **(4+4=8)**

   (d) Write briefly on: (i) functions of lymphatic system, (ii) sensory cranial nerves (name and functions) **(4+3=7)**

L-1/T-1/BME **Date : 01/10/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B.Sc. Engineering Examinations 2017-2018

Sub : **CHEM 125** (Organic and Inorganic Chemistry)

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) Draw the structure of the following compounds: **(3)**
   (i) tert-butylcyclopentane
   (ii) 1-ethyl-3-methylcyclohexane
   (iii) (2-cyclobutylheptane)

   (b) Why do a branched alkane have lower boiling point than linear alkane? Explain. **(5)**

   (c) Show the mechanism of hydrogenation of unsaturated hydrocarbons. **(6)**

   (d) Write down the reaction mechanism involved in the chlorination of ethane under diffuse sunlight. **(6)**

   (e) How can you prepare alkane from alkylhalide through Corey-House Synthesis process? **(7)**

   (f) Why do a chair form of cyclohexane is the most stable form than others? Explain with diagram. **(8)**

2. (a) What are E-and Z-isomers? Why Z-isomer shows higher boiling point than E-isomer? Explain with examples. **(5)**

   (b) Draw the structure of the following alkanes: **(2×4=8)**
   (i) 2-Methyl-bicyclo[3.2.2]non-6-ene
   (ii) Bicyclo[3.2.1]oct-2-ene
   (iii) 3-methylcycloheptene
   (iv) 1,6-dimethylcyclohexene.

   (c) Show the mechanism for the synthesis of 3-bromo-2-butanol from butane-2. **(5)**

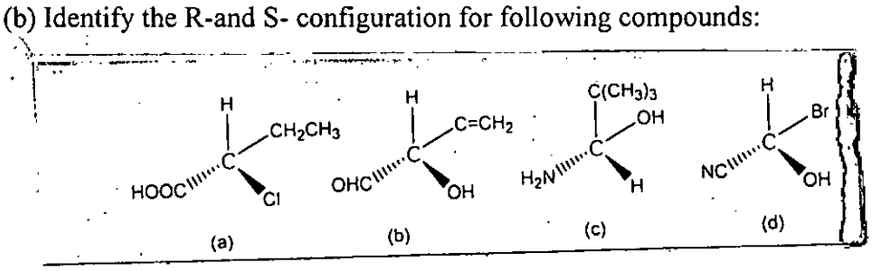
   (d) Give the mechanism for the formation of dichlorcarbene and stereospecific addition of dichlorocarbene to cyclohexene. **(7)**

   (e) Write down the mechanism of acid catalyzed hydration of alkyne to synthesis of ketone. **(6)**

   (f) Why acetylinic proton is more acidic than ethylinic proton? Explain with hybridization of carbon. **(4)**

3. (a) Define stereogeneic center. Level stereogeneic centers and draw all possible stereoisomers of $CH_3CH(OH)CH(OH)COOH$. **(8)**

   (b) Identify the R-and S- configuration for following compounds: **(2×4=8)**



Contd P/2

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Contd... Q. No. 3

(c) Discuss the chirality of amines when three different groups are bonded with nitrogen atom. Show diagram with hybridization. **(8)**

(d) Show the mechanism for the preparation of amine from ketone through reductive amination method. **(6)**

(e) Give the mechanism for the preparation of iodobenzene from benzenediazonium salt. **(5)**

4. (a) Write down the properties of IR active molecules with examples. **(5)**

(b) How can you monitor a completion of dehydrogenation of alcohols with the help of IR spectrometer? **(5)**

(c) What are the criteria of NMR active compounds? Explain with examples. **(5)**

(d) What is anisotropic effect? Give examples. **(8)**

(e) Explain the possible spectroscopic analysis of $CH_3CH_2CH_2CH_2OH$. **(12)**

SECTION - B

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

5. (a) Give two pieces of evidence for the wave model and two for the particle model of light. **(8)**

(b) What new idea about light did Einstein use to explain the photoelectric effect? Why does the photoelectric effect exhibit a threshold frequency but not a time lag? **(2+5)**

(c) Why can't we overcome the uncertainty predicted by Heisenberg's Principle by building more precise instruments to reduce the error in measurements below the $h/4\pi$ limit? ($h = 6.626\times10^{-34}$ kg.m^2/s). **(6)**

(d) A sodium flame has a characteristic yellow color due to emissions of wavelength 589 nm. What is the mass equivalence of one photon with this wavelength (1 J = 1 kg.m^2/s^2 and speed of light = 3.00×10^8 m/s.)? **(8)**

(e) The electron configuration of an atom is $1S^22S^22P^63S^2$. Write a complete set of quantum numbers for each of the electrons. **(6)**

6. (a) How many electrons in a single atom can have the following two quantum numbers: n = 7, m_l = -3? **(6)**

(b) Consider both the filled and unfilled orbitals of element **X**. Determine the number of (i) total nodes in a 3d orbital (ii) angular nodes in the $4p_y$ orbital (iii) degenerate 2p orbitals. **(2×3)**

Contd P/3

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Contd... Q. No. 6

(c) Define iso-electronic species. Explain why the anions are larger than the cation. Arrange the following species as iso-electronic pairs with electron configurations: O^+, Ar, S^{2-}, Ne, Zn, Cs^+, N^{3-}, As^{3+}, N, Xe, etc. **(2+2+8)**

(d) Define effective nuclear charge Z_{eff}. Sketch the outline of the periodic table and identify groups containing alkali metals, halogens and chalcogans. **(2+5)**

(e) Comment on the following observations: (i) First ionization energy of 'N' is more than 'O' (ii) Electron affinity of Noble gases are positive but for 'Be' is almost zero. **(2+2)**

7. (a) Write Lewis structures for the following species, including all resonance forms, show formal charges, name the geometry around the central atom: (i) SO_2 (ii) OCN^- (iii) NNO (atom order as indicated) **(5×3)**

(b) Draw shapes of H_2O, SF_4, XeF_4 and CO_2 molecule showing hybridization, all bonding orbitals and lone pairs. **(4×3)**

(c) Sketch the shapes of the following molecular orbitals: (i) σ_{1s}; σ_{1s}* (ii) π_{2p}; π_{2p}*. **(4)**

(d) Molecular oxygen shows paramagnetic property – explain. **(4)**

8. (a) "*cis*-1,2-dichloroethylene ($C_2H_2Cl_2$) boils 13°C higher than *trans*-1,2 dichloroethylene – explain. **(4)**

(b) Draw molecular orbital diagram for N_2^+ molecule. Write the **valence** electron configuration of this molecule and compare it's bond energy and bond length with N_2 molecule. **(8)**

(c) What effect of 2s-2p mixing is observed in relative energy level of molecular orbitals (MOs) in homonuclear diatomic molecules of period 2 elements. **(6)**

(d) Can one half reaction of a redox process take place independently of other? Explain. **(5)**

(e) Balance the following skeleton and identify the oxidizing and reducing agents: **(4×3)**

(i) $ClO_3^-(aq) + I^-(aq) \rightarrow I_2(s) + Cl^-(aq)$ [acidic]

(ii) $MnO_4^-(aq) + SO_3^{2-}(aq) \rightarrow MnO_2(s) + SO_4^{2-}(aq)$ [basic]

(iii) $MnO_4^-(aq) + H_2O_2(aq) \rightarrow Mn^{2+}(aq) + O_2(g)$ [acidic]
