L-1/T-1/ME **Date : 21/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **MATH 161** (Differential Calculus, Solid Geometry and Vectors)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meanings.

SECTION – A

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

1. (a) Find the n-th derivative of $sin^4 x cos^3 x$. **(15)**

(b) If $y = \sin\left(a \sin^{-1} x\right)$, then prove that **(15)**

$$\left(1-x^2\right)y_{n+2} - (2n+1)xy_{n+1} - \left(n^2 - a^2\right)y_n = 0$$

(c) If $u = \tan^{-1} \dfrac{x^2+y^2+z^2}{x+y+z}$, then show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} + z\dfrac{\partial u}{\partial z} = \dfrac{1}{2}\sin 2u$. **(16⅔)**

2. (a) Evaluate: (i) $\lim\limits_{x\to 0}\left\{\dfrac{1}{x} - \left(\dfrac{1}{x^2}\right)\ln(1+x)\right\}$. **(20)**

(ii) $\lim\limits_{x\to 0}\left(\cot^2 x\right)^{\sin x}$

(b) Using Mean Value theorem prove that, $\sqrt{\left(\dfrac{1-x}{1+x}\right)} < \dfrac{\ln(1+x)}{\sin^{-1} x} < 1$, when $0 < x < 1$. **(15)**

(c) Expand $\dfrac{1}{1-x}$ in power of x with Lagrange form of remainder after n terms and find the value of θ in R_n. **(11⅔)**

3. (a) Find the maximum and minimum value of the function $4 \sin x \cos^2 x$. **(15)**

(b) Prove that the radius of curvature of the ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$, at an end of major axes is half of its latus rectum. **(16⅔)**

(c) Find the equation of tangent and normal to the curve $y(x-2)(x-3) - x + 7 = 0$ at the point of x interception. **(15)**

4. (a) Find all the asymptotes of the curve $x^3 - 2y^3 + xy(2x-y) + y(x-y) + 1 = 0$. **(15)**

(b) Find the angle between the tangent to the curve $r = a(1-\cos\theta)$ and the radius vector. **(15)**

(c) Find the envelopes of the family of parabola $\sqrt{\dfrac{x}{a}} + \sqrt{\dfrac{y}{b}} = 1$, where $a^n + b^n = c^n, a, b$ being parameters. **(16⅔)**

Contd P/2

MATH 161(ME)

SECTION-B

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

5. (a) Find the direction cosines of a line which is perpendicular to the lines whose direction ratios are (1, -1,2) and (2,2,-1). **(10)**

(b) A variable plane passes through a fixed point (α,β,γ) and meets the axes in A,B,C. Show that the locus of the point of intersection of the planes through A,B,C parallel to the coordinate plane is $\frac{\alpha}{x}+\frac{\beta}{y}+\frac{\gamma}{z}=1$. **(21⅔)**

(c) Reduce to symmetrical form the line given by the equations $x+y+z+1=0$ and $4x+y-2z+2=0$. Hence find the equation to the plane through the point (1,1,1) and perpendicular to the given line. **(15)**

6. (a) Find the length of the shortest distance between the lines $\frac{x-3}{1}=\frac{y-5}{-2}=\frac{z-7}{1}$; $\frac{x+1}{7}=\frac{y+1}{-6}=\frac{z+1}{1}$. Find also its equations and the points where it intersects the lines. **(20)**

(b) Suppose $\frac{x}{2}=\frac{y}{-3}=\frac{z}{6}$ be the equation of the line AB. Through a point $P(1,2,5)$, PN is drawn perpendicular to AB and PQ is drawn parallel to the plane $3x+4y+5z=0$ to meet AB in Q. Find the equation of the line PN and PQ and the coordinates of N and Q. **(26⅔)**

7. (a) Three vectors of magnitudes k, 2k and 3k meet in a point and their directions are along the diagonals of the adjacent faces of a cube. Determine their resultant and its direction cosines. **(26⅔)**

(b) A rigid body is spinning with an angular velocity of 6 radians per second about an axis of direction (0, -4, 3) passing through the point (4, 3, -2). Find the linear velocity of the particle at the point (5, -3, -7). **(10)**

(c) Give the geometrical interpretation of the scalar triple product. **(10)**

8. (a) If **a, b, c** be three non-coplanar vectors and **a′, b′, c′** constitute the reciprocal system of vectors, then prove that any vector **r** can be expressed as **r = (r.a′)a + (r.b′)b + (r.c′)c**. **(15)**

(b) If **a, b, c** are the position vectors of the non-collinear points A, B, C respectively in space, show that **a × b + b × c + c × a** is perpendicular to the plane ABC. **(15)**

(c) Solve the vector equation **(a.x)a – x × a + b** = 0 for the vector **x**. **(16⅔)**

L-1/T-1/ME Date : 17/08/2017

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **CHEM 109** (Chemistry I)

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 integrated rate equation for the reaction A → P and find the half-life for such a reaction. **(12)**

   (b) Define the energy of Activation and show its application through neat diagram. **(5)**

   (c) Name the methods to determine order. Explain any two of the methods. **(10)**

   (d) For a first order reaction, the half-life is 500 seconds. At what time, one fourth of the reactant with remain unreacted? **(8)**

2. (a) State and explain Le Chatelier principle. What is the effect of pressure and catalyst on the equilibrium constant? Give examples. **(12)**

   (b) The relationship between equilibrium constant and temperature is not linear but exponential. Prove the above statement through derivation of an equation. Show its application as well. **(14)**

   (c) 35% N_2O_4 is dissociated at 100°C. If the total pressure is 1.5 atm., find out the values of Kp and Kc. **(9)**

3. (a) What are colligative properties? Why are they so called. What are the characteristics of an ideal solution? **(6)**

   (b) Define vapour pressure and the boiling point of a liquid. Derive a mathematical relation correleating molecular weight of a solute and the boiling point of its dilute solution. **(14)**

   (c) State Henry's law and show the effect of temperature on the solubility of a gas in liquid. **(8)**

   (d) What is ebullioscopic constant (K_b)? The boiling point of an aqueous solution of sugar containing 1.5 gm sugar in 100 gm solvent is 101.5°C. Calculate the K_b of the solvent. **(7)**

4. (a) Define and explain with suitable examples the heat of formation and heat of combustion. Describe with a diagram how heat of combustion is found out in the laboratory. **(12)**

Contd P/2

CHEM 109(ME)

Contd ... Q. No. 4

(b) Show the relationship between K_p and K_c through derivation. **(7)**

(c) Derive the rate law for a reaction at equilibrium $A \rightleftharpoons P$. **(10)**

(d) Define Molarity (M), molality (m) and normality (N). **(6)**

SECTION – B

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

5. (a) How Rutherford summarises his results of gold foil experiments? **(7)**

(b) What is the wavelength of a photon (in nanometer) emitted during a transition from $n_i = 5$ state to $n_f = 2$ state in the hydrogen atom which can be visible as a line in line spectra? Which series of lines it belongs to? Draw the other possible lines of the series [Rydberg's constant = 2.18×10^{-18} J. **(6+3+3=12)**

(c) Schrödnger equation is quite complex but can be represented in simpler form $H\psi = E\psi$, where E is the energy and ψ is called wave function. What information we can get from ψ about the atomic system? **(6)**

(d) 'The probability of finding two electrons with the same quantum numbers in an atom is zero' – what do you think about the statement? Justify your answer. **(10)**

6. (a) From the concept of magnetism how can you prove the Pauli's exclusion principle? **(7)**

(b) Arrange the ions according to their size. Explain your answer. **(8)**

(i) K^+, Sc^{3+}, Ca^{2+} and (ii) P^{3-}, Cl^-, S^{2-}

(c) Define ionization energy'. How can you explain the lower ionization energy of Oxygen compared to that of Nitrogen? **(2+5=7)**

(d) What will be the change of potential energy of the system when two atoms are getting closer to form a covalent bond? Draw the potential energy diagram in covalent bond formation. Show that the bond length and bond dissociation energy can be calculated from such diagram. **(8+5=13)**

7. (a) Draw a trigonal bipyramidal geometry and mark the axial and equitorial positions. Which position is suitable for the accommodation of a lone pair in the system? Explain. **(4+4=8)**

(b) Predict and draw the geometry of the followings **(9)**

(i) SO_2 (ii) PO_4^{3-} (iii) I_3^-

(c) What is the hybridized state of Oxygen in water? Draw the hybridized orbital of water. **(7)**

(d) Determine the bond orders of the following species: (i) F_2^{2-} (ii) F_2^- (iii) F_2^+ (iv) F_2^{2+} **(3+4+4=11)**

List the species in order of increasing bond energy and in order of increasing bond length.

Contd P/3

CHEM 109(ME)

8. (a) Draw the schematic diagram of two types of electrochemical cells (voltaic and electrolytic) and answer the followings: **(6+5+4+3+5+3=26)**

(i) Define anode and cathode in terms of oxidation and reduction.

(ii) In which type of cell the chemical reactions happen spontaneously if proper arrangement is maintained?

(iii) What is the relation between free energy and the spontaneity of a reaction?

(iv) If a hydrogen gas electrode is used as a cathode in voltaic cell then write down the cell reaction with cell notation (consider reaction happens spontaneously)

(v) Why it is important to use a salt bridge in a voltaic cell?

(b) Lead can displace silver from solution.

$$Pb(s) + 2Ag^{+}(aq) \rightarrow Pb^{2+}(aq) + 2Ag(s)$$ **(9)**

Silver occurs in trace amounts in some ores of lead. As a consequence, silver is a valuable by product in the industrial extraction of lead from its ores. Calculate equilibrium constant K and free energy change ΔG° at 298.15 K for this reaction.

[$E^{\circ}_{Ag^{+}/Ag}$ = 0.80 V and $E^{\circ}_{Pb^{2+}/Pb} = -0.13$ V].

L-1/T-1/ME **Date : 17/07/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **ME 101** (Introduction to Mechanical 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** questions.

1. (a) Define engineering ethics. Why is it important to practice engineering ethics in professional life? **(8)**

   (b) What are the gray areas of engineering ethics? What are the factors that affect these gray areas and how? Explain with examples. **(15)**

   (c) Distinguish between codes and standards. Why do standards matter in engineering practice? **(12)**

2. (a) What do you understand by renewable energy? Why is the "Need for Energy" increasing around the world? **(8)**

   (b) Name the different environmental problems of global significance that are caused by the burning of fossil fuels. Describe any one of them. **(15)**

   (c) What are the most basic components of an automobile? Briefly discuss their functions. **(12)**

3. (a) Distinguish between the following: **(8)**

   (i) Substrate and additive films.

   (ii) Surface micromachining and bulk micromachining.

   (b) With the help of a suitable schematic diagram, explain the sputtering process of microfabrication. **(12)**

   (c) What do you understand by actuators used in mechatronic systems? Give examples of different kind of actuating systems. **(8)**

   (d) Classify robots. What are the features of an intelligent robot? **(7)**

4. (a) What do you understand by the cooling load of a building? What are the different components of cooling load? **(8)**

   (b) What is a central air-conditioning system? With the help of a suitable diagram, explain the working principle of 'all water' central air conditioning system. **(15)**

   (c) What do you understand by the terms COP, EER and Ton of refrigeration? Compare vapor compression and vapor absorption refrigeration systems. **(12)**

Contd P/2

ME 101/ME

SECTION – B

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

5. (a) Compare between the major features of SI engines and CI engines. **(11)**

   (b) What do you understand by "Piston Clearance"? Why is it a very important parameter influencing engine performance? **(8)**

   (c) Distinguish between "In-block Cam" and "Overhead Cam" of an engine. What do you understand by DOHC? **(8)**

   (d) Briefly state the functions of the lubrication system in a reciprocating IC engine. **(8)**

6. (a) Briefly explain the difference of operation of a Gas-turbine and a Jet-engine. **(10)**

   (b) Which types of Jet engines are used in (i) Modern passenger aircrafts and (ii) Helicopters? How are they different in operation? **(8)**

   (c) What do you understand by Mach number? Why do most passenger jets fly at subsonic speed and at high altitude? **(8)**

   (d) State the advantages of a 2-stroke engine compared to a 4-stroke one. Why are the uses of 2-stroke engines very limited now-a-days? **(9)**

7. (a) Distinguish between SPI and MPFI fuel systems for an SI engine. State the advantages of MPFI system compared to carburetors. **(9)**

   (b) Draw a schematic diagram identifying the major components of a spark ignition system of an engine. What do you understand by "Electronic Ignition"? Briefly explain. **(13)**

   (c) Define "Compression Ratio" of a reciprocating IC engine. Why do we use higher compression ratio for Diesel engines? **(7)**

   (d) A diesel engine has a BSFC of 240 g/kW-h at its rated power of 100 kW. Calculate its fuel consumption rate in liters/hour if the specific gravity of diesel fuel is 0.84. **(6)**

8. (a) Define - Subcritical, Super Critical and Ultra Super Critical Boilers. Which type is used in modern steam power plants? **(8)**

   (b) What do you understand by "Boiler Mountings" and "Boiler Accessories"? Give three examples of each category. **(7)**

   (c) Briefly explain the use of "Super heater" and "Economizer" in a boiler. How do they improve boiler performance? **(10)**

   (d) Briefly explain the role of "Thermostatic valve" and "Electric Fan" in the typical water cooling circuit of an automotive engine. **(10)**

L-1/T-1/ME **Date : 12/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **EEE 159** (Fundamental of Electrical 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) Calculate the equivalent resistance R_{ab} and R_{cd} in the circuit shown in Fig. for 1(a). **(18)**

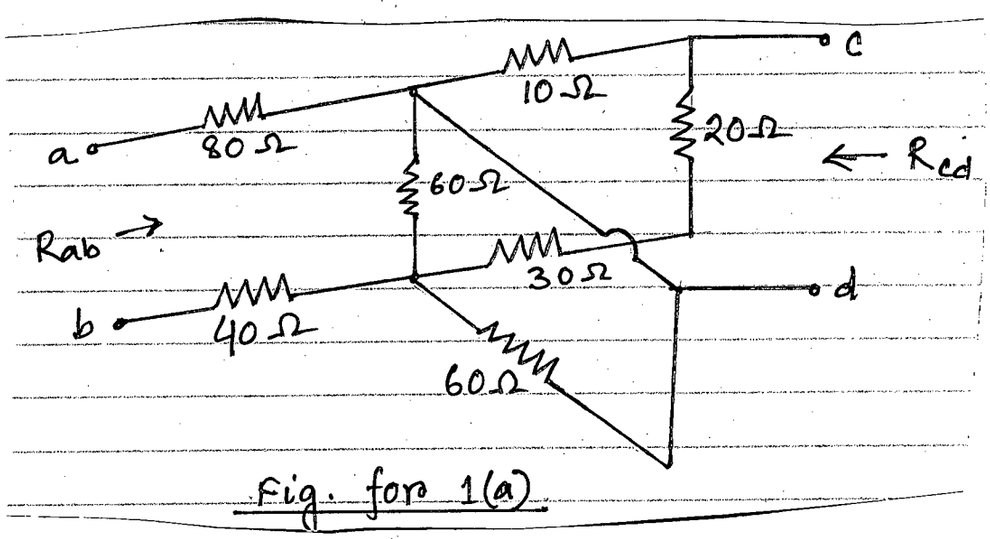

Fig. for 1(a)

(b) Use Nodal Analysis to find the power dissipated in Ro resistance when Ro = 16 Ω. **(17)**

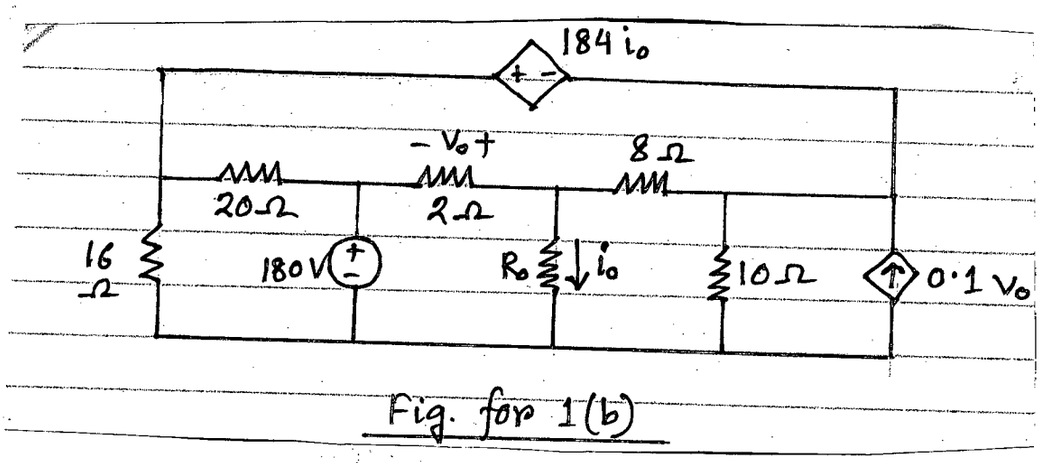

Fig. for 1(b)

2. (a) For the circuit shown in Fig. for 2(a), find the voltage V_{ab} and the power dissipated in 10 Ω resistance. **(10)**

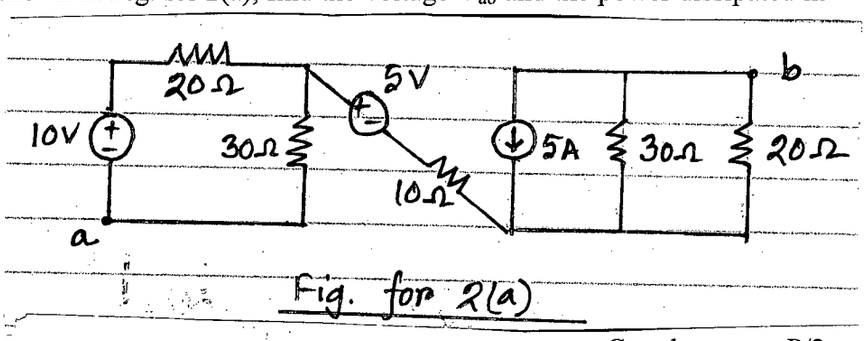

Fig. for 2(a)

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EEE 159(ME)

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(b) For the circuit in Fig. for Q. 2(b), find the Thevenin and Norton Equivalent with respect to terminals a and b. **(15)**

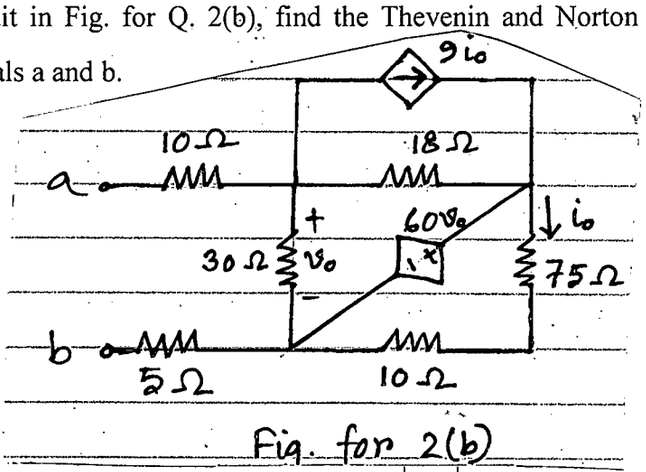


Fig. for 2(b)

(c) For the circuit in Fig. for 2(c), find out V_{out}, I_{out}, $\left|\frac{V_{out}}{V_{in}}\right|$. **(10)**

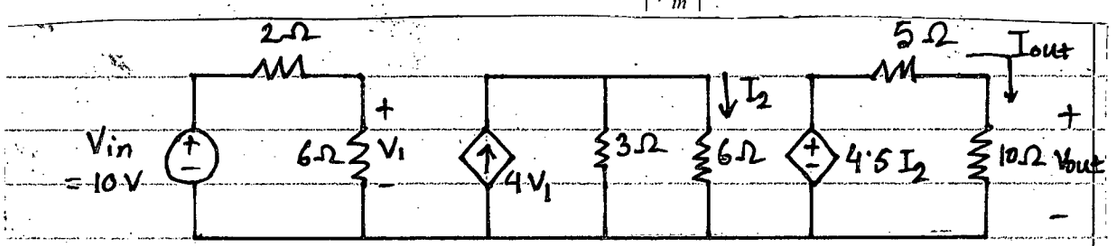


Fig. for 2(c)

3. (a) Use Mesh Analysis to find all the indicated branch currents for the circuit in Fig. for 3(a). Also show that the total power generated equals the total power absorbed. **(25)**

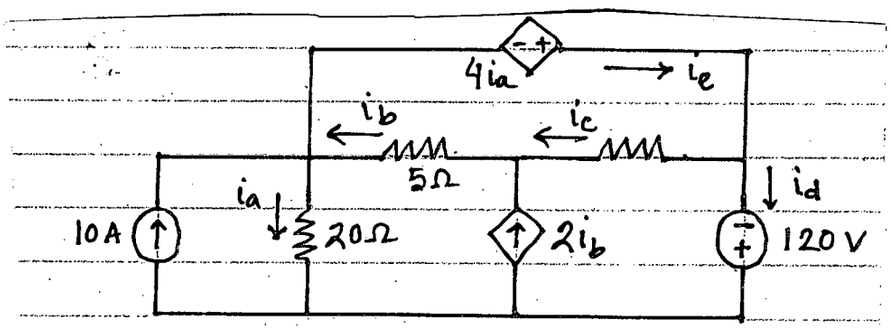


Fig. for 3(a)

(b) Apply source transformation at the circuit part in indicated boxes and then find V_1 and V_2 by nodal analysis for the circuit in Fig. for 3(b). **(10)**

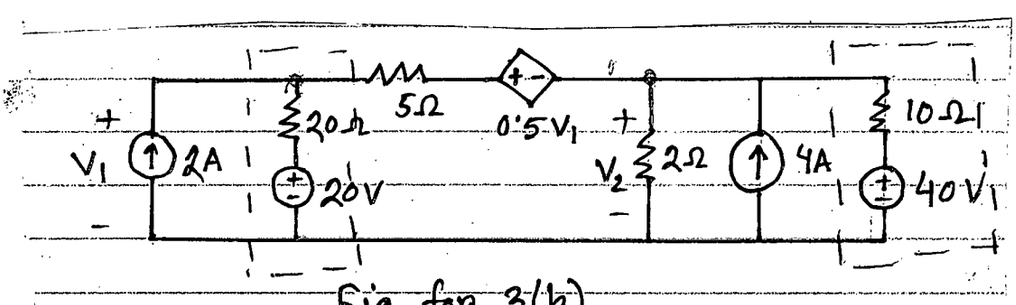


Fig. for 3(b)

EEE 159(ME)

4. (a) In the circuit of Fig. for 4(a), the current 'I' before connecting the branch with current source is 0.222 A. What is the change in the current I after connecting the branch. **(10)**

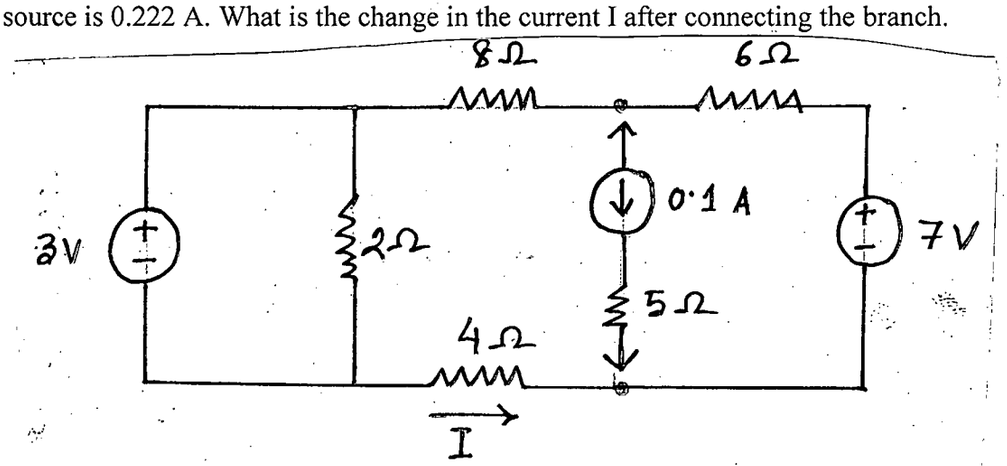


Fig. for 4(a)

(b) In the circuit of Fig. for 4(b), when an ammeter is used to measure the current i_o, it reads 3 A. What is the resistance of the ammeter? What is the percentage of error in the ammeter reading? **(15)**

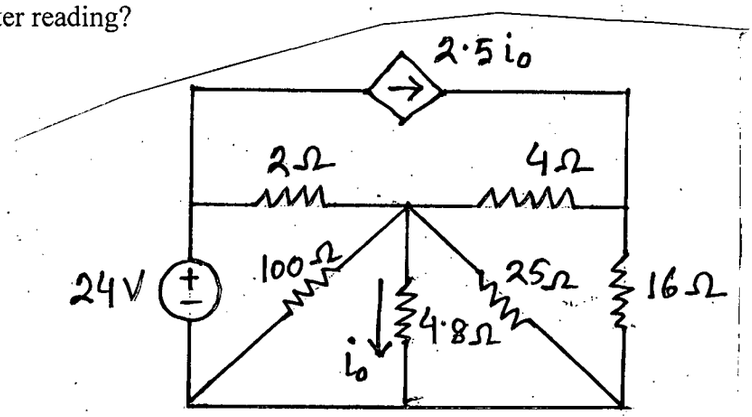
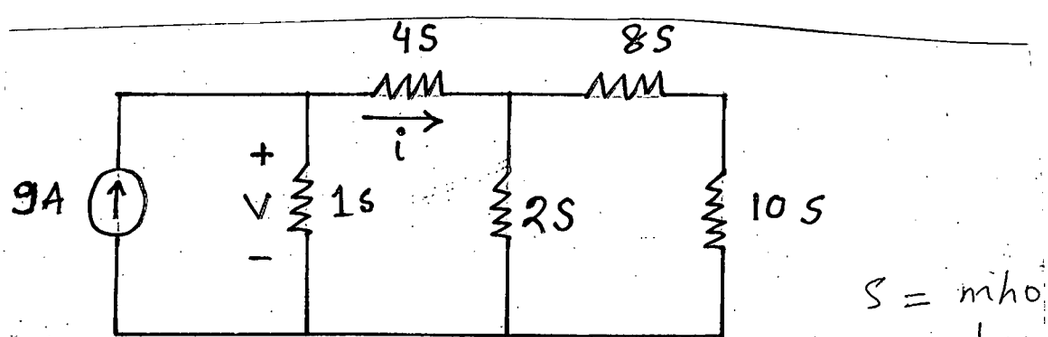


Fig for 4(b)

(c) Find v and i in the circuit of Fig. for 4(c). **(10)**



S = mho
$= \frac{1}{\text{ohm}}$

Fig. for 4(c)

EEE 159(ME)

SECTION – B

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

5. (a) The following voltage and current data were found while varying load impedance of the outlet of a complicated network. **(20)**

I (Amp)	V (Volt)
$0.54\angle 42.23°$	$5.51\angle 30.92°$
$0.56\angle 39.22°$	$5.07\angle 32.88°$
$0.54\angle 54.4°$	$5.596\angle -26.14°$
$0.54\angle 50°$	$6.5\angle 27.38°$
$0.57\angle 50°$	$5.87\angle 20.945°$

Now find the Thevenin equivalent of the network.

(b) Derive maximum power transfer theorem for ac circuits. Explain why the power factor is 1 at the maximum power transfer condition. **(15)**

6. (a) Show that the total real power delivered in a three-phase balanced system is constant. **(10)**

(b) Two balanced loads are connected to a 240-kV rms 60-Hz line, as shown in Fig. for Q. 6(b). 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. Assuming the *abc* sequence, determine: (a) the complex, real, and reactive powers absorbed by the combined load, (b) the line currents, and (c) the kVAR rating of the three capacitors connected in parallel with the load that will raise the power factor to 0.9 lagging and the capacitance of each capacitor. Assume capacitors are to be Y connected. **(25)**

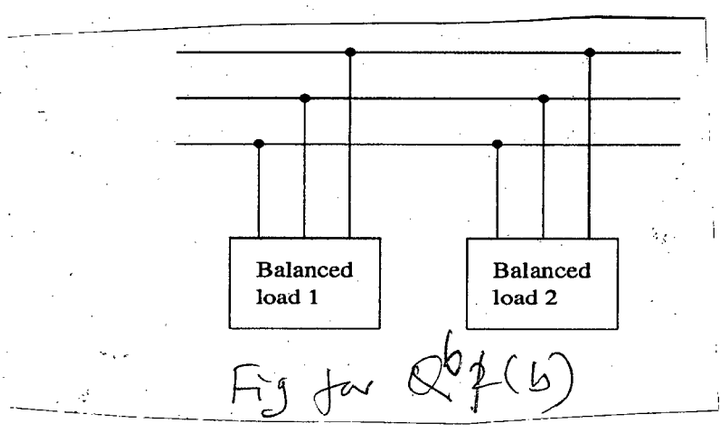


Fig for Q6(b)

7. (a) Draw the phasor diagram of the following circuit. (Fig. for Q 7(a)) **(10)**

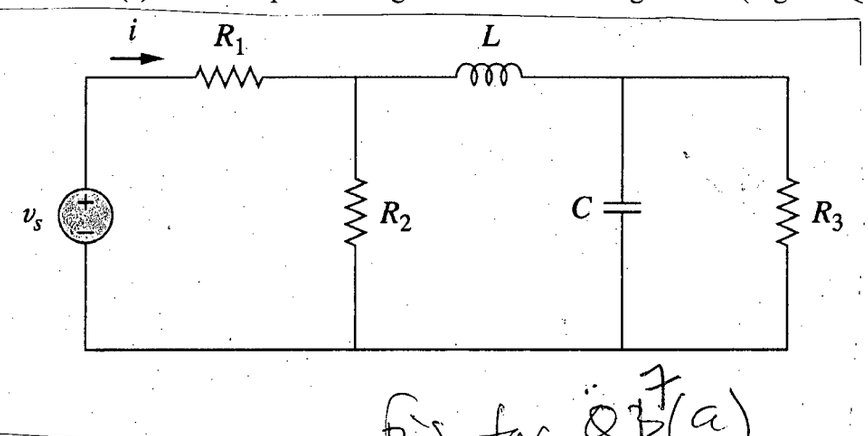
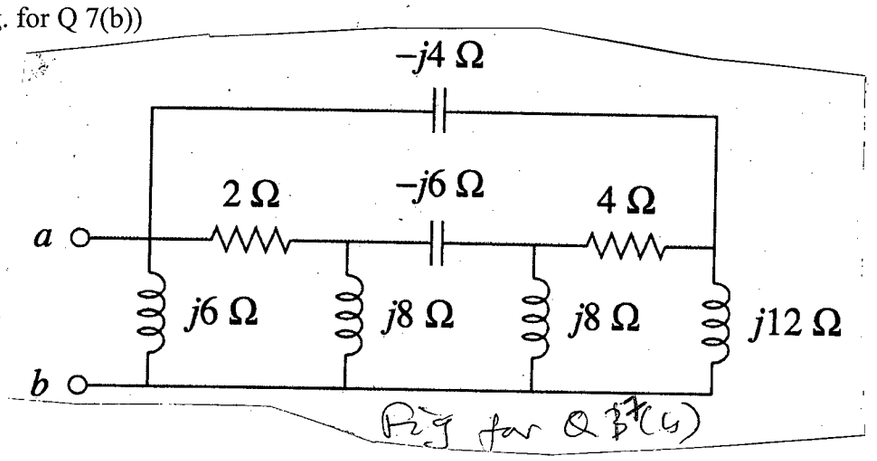


Fig for Q7(a)

Contd P/5

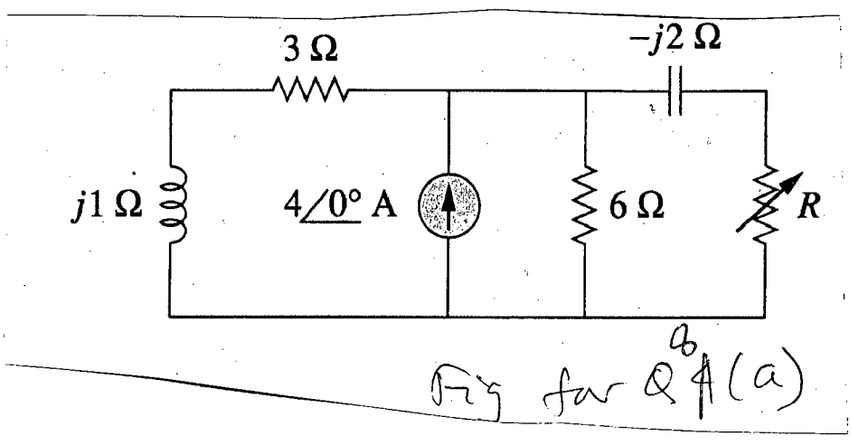
EEE 159(ME)

(b) Determine the equivalent impedance between terminals a-b of the following circuit. (Fig. for Q 7(b)) **(15)**

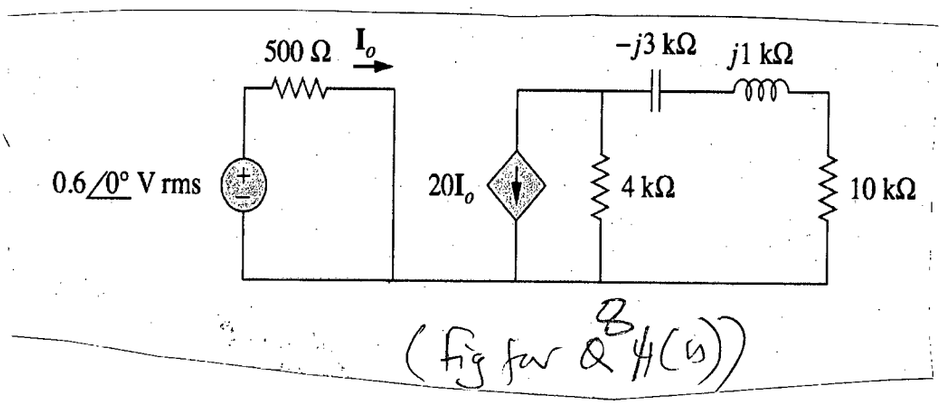


(c) Prove that a pure capacitor does not consume power in a full cycle of the input voltage. **(10)**

8. (a) The variable resistor R in the circuit of the following figure (Fig. for Q 8(a)) is adjusted until it absorbs the maximum average power. Find R and the maximum average power absorbed by R. **(20)**



(b) Obtain the complex power delivered to the 10-kΩ resistor in the following figure. (Figure for Q. 8(b)) **(15)**



L-1/T-1/ME **Date : 06/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **PHY 105** (Structure 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) Explain time dilation and length contraction in special theory of relativity. **(8)**

   (b) Obtain expressions for relativistic time and relativistic length in inertial frame of references. **(20)**

   (c) How much time does a meter stick moving at 0.100 c relative to an observer take to pass the observer? The meter stick is parallel to its direction of motion. **(7)**

2. (a) What is Compton effect? Obtain an expression for the change in wavelength of an incident X-ray photon on an electron at rest. **(6+22)**

   (b) A beam of X-rays is scattered by a target. At 45° from the beam direction, the scattered X-rays have a wavelength of 2.2×10^{-12} m. What is the wavelength of the X-rays in the direct beam? **(7)**

   (given: Electron rest mass = 9.1×10^{-31} kg and Speed of light = 3.0×10^{-8} m/s.
   Planck Constant = 6.626×10^{-34} J-s)

3. (a) What is a wave function? Discuss the physical significance of wave function. **(8)**

   (b) Show that the Bohr model of orbital stability can be explained from the matter wave concept and hence obtain the expressions for Bohr radius and radius of the orbitals in case of hydrogen atom. **(20)**

   (c) Find the de Broglie wavelength of a 1.00 MeV proton. Is a relativistic calculation needed? **(7)**

4. (a) Discuss Coulomb's law and Gauss's law in electrostatics. With a suitable example, show that electric charge is conserved. **(10)**

   (b) Define electric field $\vec{E}$. Obtain an expression for the electric field $\vec{E}$ at a distance y from an infinitely long line charge of linear charge density λ. What is an electric dipole and the dipole moment? Find the electric field $\vec{E}$ due to a dipole at a distance r along the perpendicular bisector of the dipole. Plot $\vec{E}$ for a point charge and the dipole moment $\vec{P}$ as a function of r. **(15)**

   (c) In a region an electric field is given by $\vec{E} = 2\hat{i} + 3\hat{j} + \hat{k}$. Calculate the electric flux through the surface $S = 10\hat{i}$.

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SECTION – B

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

5. (a) Define electric potential and electric potential energy. What do you mean by equipotential surfaces? Draw electric field lines and equipotential surfaces and uniform electric field lines for a point charge, and an electric dipole. **(10)**

(b) Fig. 5(b) shows a thin nonconducting rod of length L and a linear positive charge density λ. Determine the electric potential V due to the rod at point P, a perpendicular distance d from the left end of the rod. **(15)**

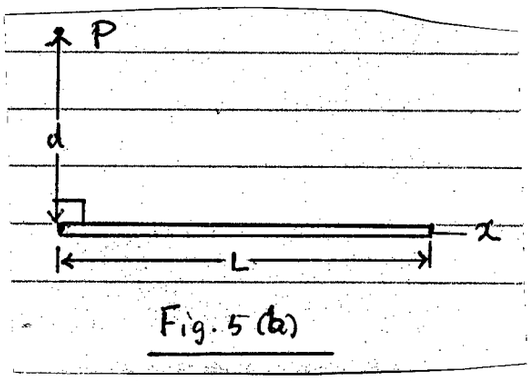

Fig. 5 (b)

(c) In a given lightning flash, the potential difference between a cloud and the ground is 1.0×10^9 V and the quantity of charge transferred is 30 coulomb. **(10)**

(i) What is the change in energy of the transferred charge?

(ii) If all the energy released by the transfer could be used to accelerate a 1000 kg automobile from rest, what could be the automobile final speed?

(iii) If the energy could be used to melt ice, how much ice would it melt at 0°C? [The heat of fusion of ice is 3.33×10^5 J/kg]

6. (a) Discuss Ohm's law in its macroscopic form and microscopic form. Define current density, drift speed and drift velocity. What is an Ohmic and a non-Ohmic conductor? Draw current versus voltage curves for a copper conductor, a diode, and a thermistor. **(10)**

(b) According to quantum physics the electrons move through a conductor with a single effective speed $V_{eff} \approx 1.6 \times 10^6$ m/s. Using the microscopic form of Ohms law, show that when an electric field E is applied across a conductor, the resistivity is given by the equation

$\rho = \frac{m}{e^2 n \tau}$, where the symbols have their usual meanings. What could you conclude about resitivity of a conductor from this equation? **(15)**

(c) The current density in a cylindrical wire of radius R = 2.0 mm (as shown in Fig. 6(c)) by $J = 2.0 \times 10^5$ A/m^2. (i) Calculate the current through the outer portion of the wire between radial distance R/2 and R. (ii) If the current density through a cross-section varies with radial distance r as $J = ar^2$ in which $a = 3.0 \times 10^{11}$ A/m^4 and r is in meters, calculate now the current through the same outer portion of the wire. **(10)**

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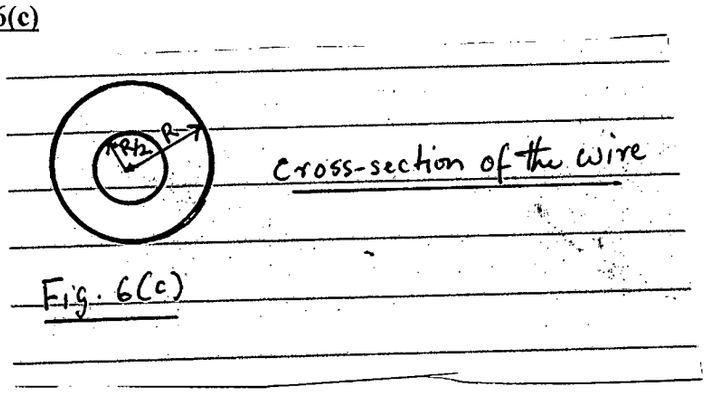

Fig. 6(c)

7. (a) Write down the significance of the statement 'Lattice + basis = Crystal structure'. Distinguish between Bravis and non-Bravis lattices. **(9)**

   (b) What are the characteristics of a primitive unit cell? Draw the primitive unit cell for a body centered cubic and a face centered cubic structure. **(12)**

   (c) Define packing fraction for crystal structure. Show that the c/a for a hexagonal closed packed (hcp) structure is 1.633, where the symbols have their usual meanings. Also calculate the packing fraction for the hcp structure. **(14)**

8. (a) How do you find the Miller indices? Draw the (100), (110) planes for a body centered cubic lattice and (100), (110), (111) planes for a face centered cubic crystal lattice. **(12)**

   (b) Explain Bragg's law for X-ray diffraction (XRD) and show that for this, wavelength of the X-rays must not be greater than twice the inter-planer spacing. Though both KCl and KBr have NaCl structure, why do their XRD patterns differ? **(11)**

   (c) Write down the importance of defects in solids? Briefly explain the Schottky and Frenkel defects in solids. **(7)**

   (d) Distinguish metals, semiconductors and insulators in the light of Band theory of solids. **(5)**
