L-1/T-2/IPE **Date : 29/06/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **EEE 167** (Basic Electrical and Electronic Circuit)

Full Marks: 280 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 the values of I and V in the following circuits (assume diodes to be ideal). **(8+8=16)**

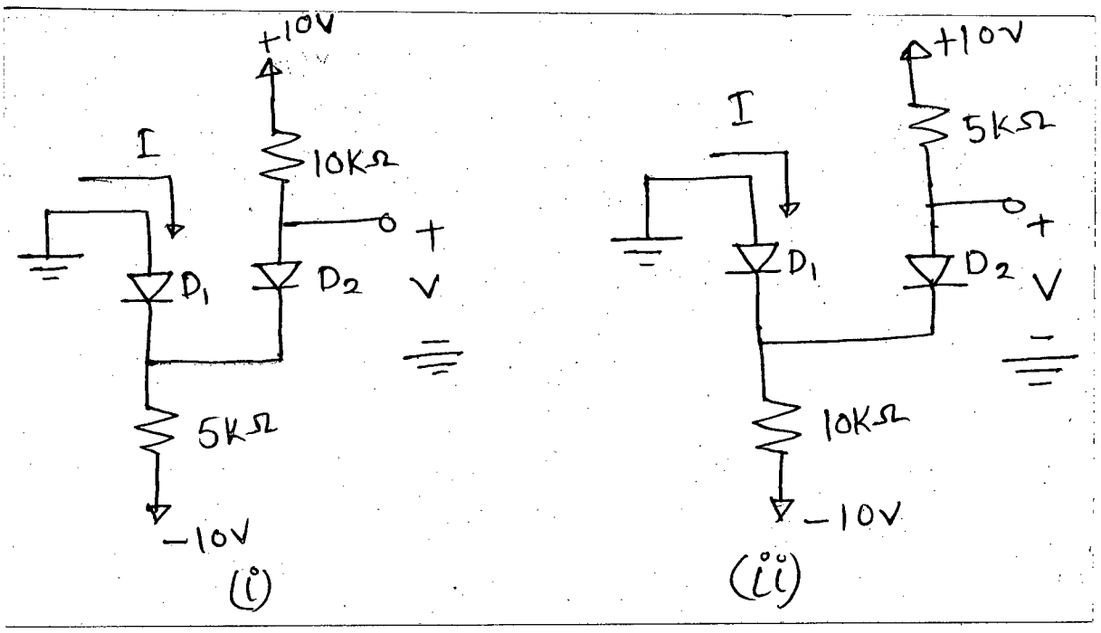

Fig. for Q. No. 1 (a)

(b) When do we apply the small signal model of a diode? Derive an expression or the small signal resistance of a diode. **(10⅔)**

(c) For the following circuits, calculate and draw the output waveforms. The input waveform is a sine wave of amplitude of 5 V and frequency of 1 kHz. Consider the diodes to be ideal. **(4×5=20)**

Contd P/2

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Contd... Q. No. 1(c)

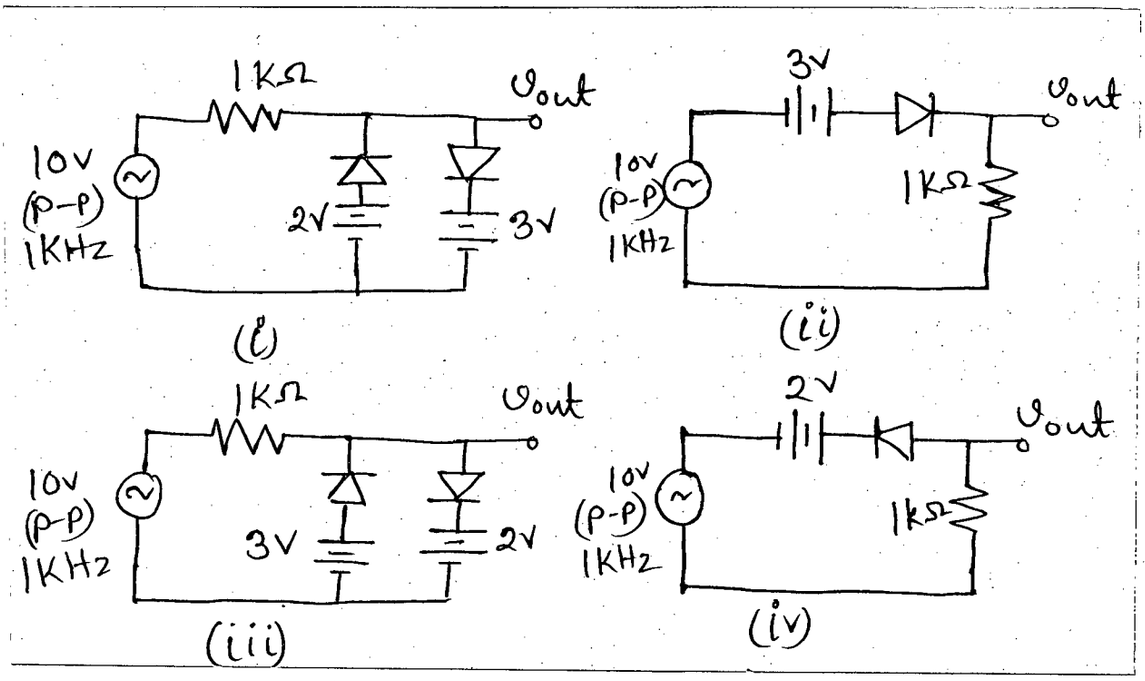

Fig. for Q. No. 1(c)

2. (a) With neat sketches derive the expression of ripple voltage for– **(20)**

   (i) Half wave rectifier

   (ii) Full wave rectifier

   (b) Using small signal approximation, derive an expression of transconductance of an NPN Bipolar Junction Transistor (BJT) **(12⅔)**

   (c) With necessary assumptions derive necessary equations for Hybrid-π model and T model of Bipolar Junction Transistor (BJT). Also, draw the equivalent circuits of two models. **(14)**

3. (a) For the following circuits, determine the values of **(10×3=30)**

   (i) Emitter Current, I_E

   (ii) Collector Current, I_C

   (iii) Base Current, I_B

   (iv) Emitter Voltage, V_E

   (v) Collector Voltage, V_C

   (vi) Base Voltage, V_B

   Assume, the transistors have $\beta = 100$ in all cases.

Contd P/3

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Contd... Q. No. 3

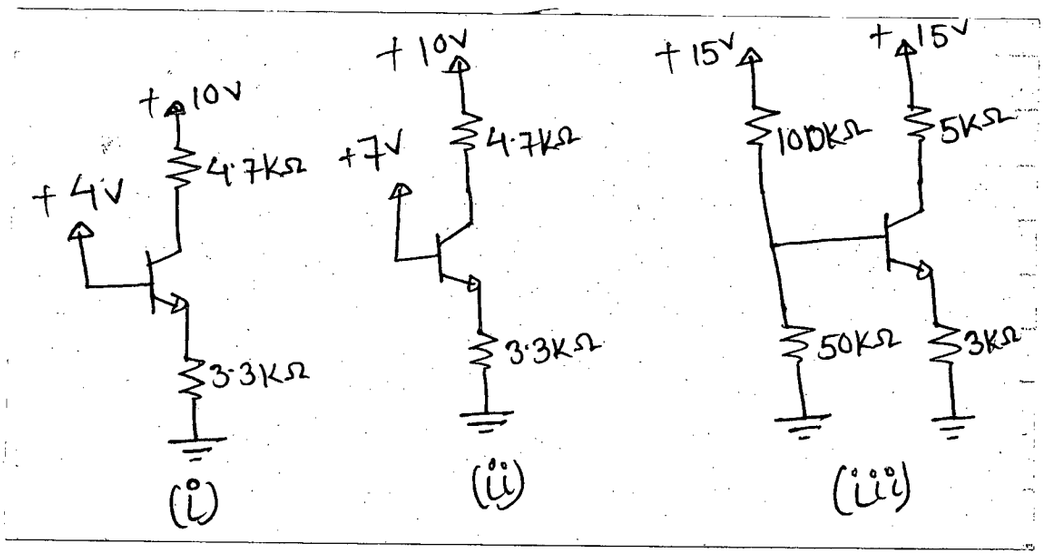

Fig. for Q. No. 3 (a)

(b) For the following BJT amplifier shown in Fig. Q. 3(b) draw the small signal equivalent circuit and derive expressions for– **(16⅔)**

(i) Input Resistance, R_{in}

(ii) Output Resistance, R_{out}

(iii) Open-Circuit Voltage Gain, A_{vo}

(iv) Overall voltage Gain, G_v

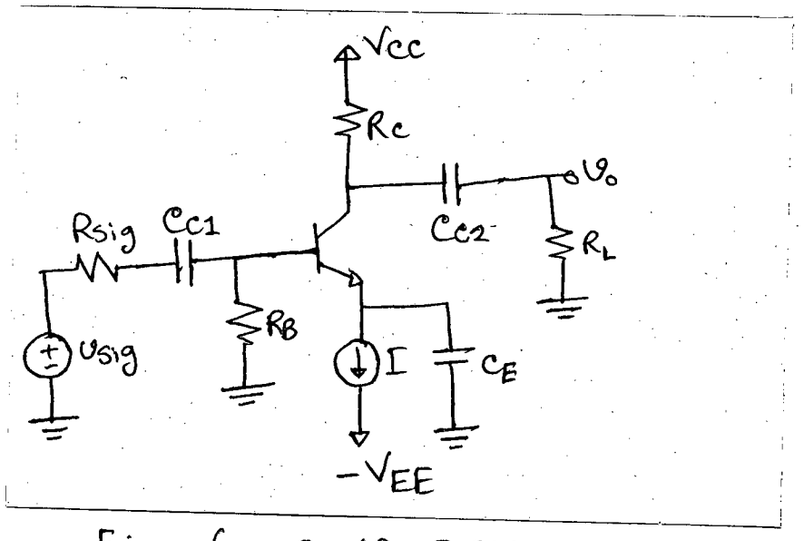

Fig. for Q. No. 3 (b)

4. (a) Two balanced loads are connected to a 240 kV rms 50-Hz line as shown in the following figure. Load1 draws 30 kW at power factor of 0.6 lagging. Load 2 draws 45 kVAR at power factor of 0.8 lagging. Assuming abc sequence, determine– **(20)**

Contd P/4

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Contd... Q. No. 4(a)

(i) The complex, real and reactive powers absorbed by the combined load

(ii) The line currents

(iii) The rating of three capacitors Δ-connected in parallel with the load that will raise the power factor to 0.85 lagging.

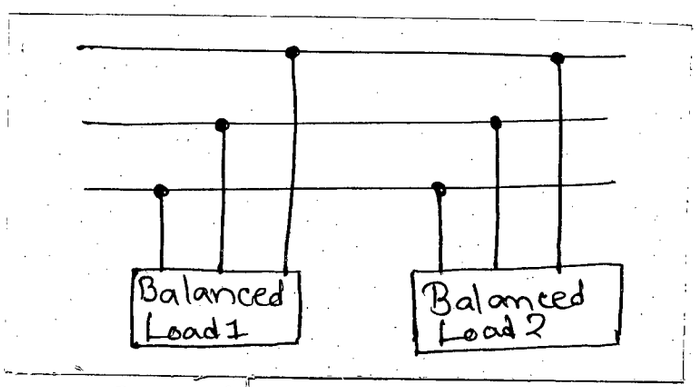

Fig. for Q. No. 4(a)

(b) For the following three phase circuit determine– **(13)**

(i) Line current

(ii) Phase current of the load

(iii) Power consumed by the 3ϕ Load.

Assume, abc phase sequence and rms values of voltages are given.

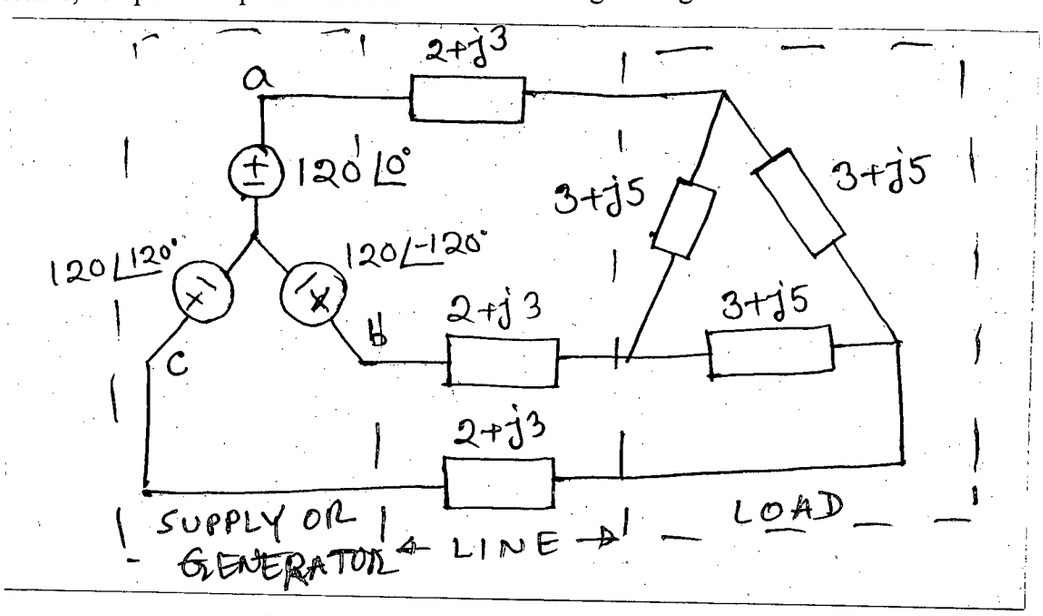

Fig. for Q. No. 4(b)

(c) For a balanced 3ϕ system, show that the average real power is time independent. **(13⅔)**

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SECTION – B

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

5. (a) Determine $V_x(t)$ for the circuit shown in Fig. for Q. No. 5(a). **(30)**

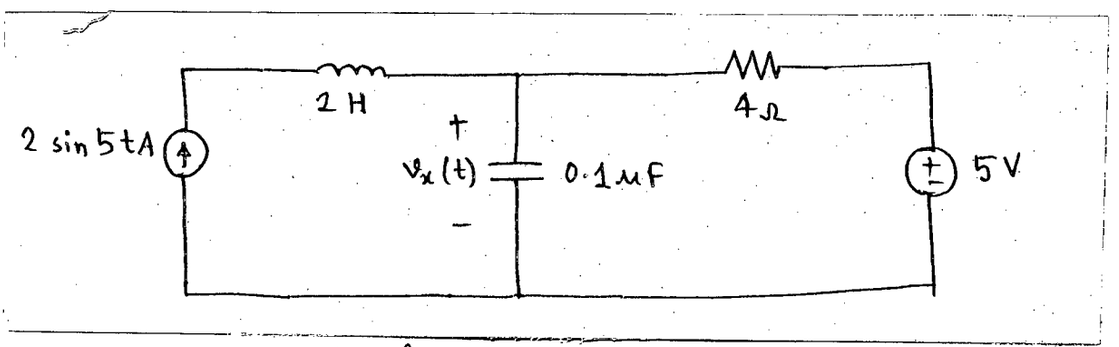

Fig. for Q. No. 5(a)

(b) For the circuit shown in Fig. for Q. No. 5(b) find the expression of V_0/V_s. If all the resistances are equal, find the value of α that will produce $V_0/V_s = 100$. **(16⅔)**

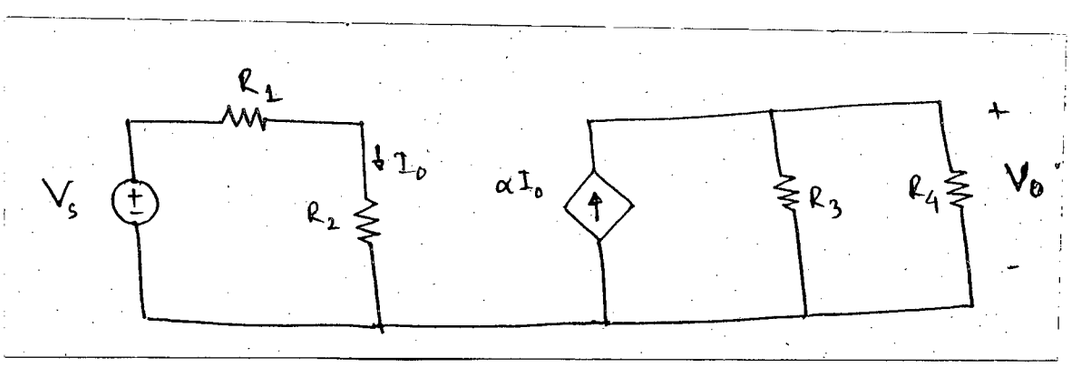

Fig. for Q. No. 5(b)

6. (a) For the circuit shown in Fig. for Q. No. 6(a) determine the value of Z_L that absorbs the maximum average power. Calculate the maximum average power drawn by Z_L. **(30)**

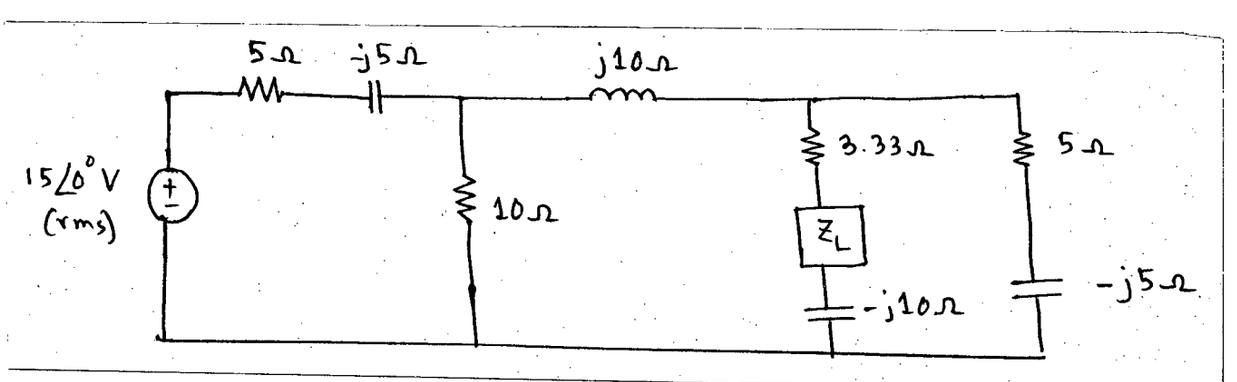

Fig. for Q. No. 6(a)

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Contd... Q. No. 6

(b) For the circuit shown in Fig. for Q. No. 6(b) the readings of the voltmeter and the ammeter are 10 V and 0.6 A respectively. Find the values of R_2 and R_3. **(16⅔)**

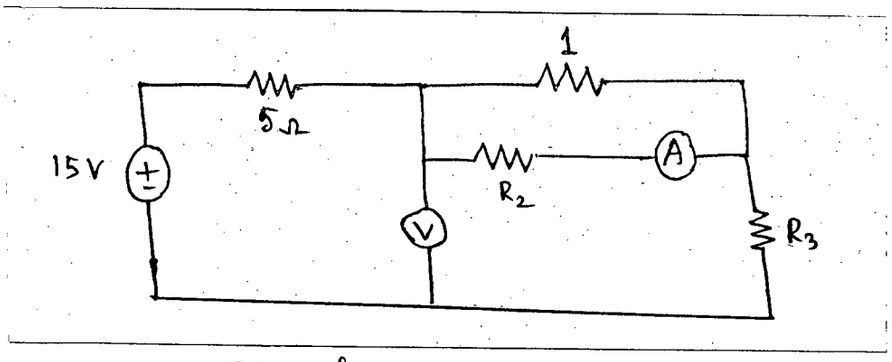

Fig. for Q. No. 6(b)

7. (a) For the circuit shown in Fig. for Q. No. 7(a) determine the complex power for all active and passive elements. Hence, show that both real and reactive powers are conserved in an ac circuit. **(26⅔)**

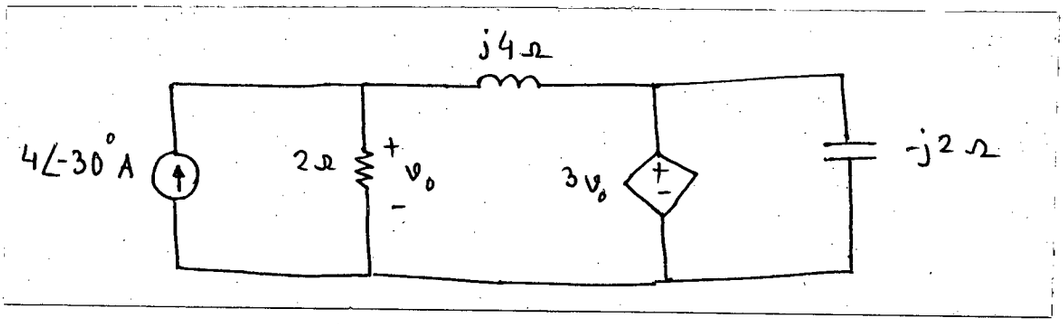

Fig. for Q. No. 7(a)

(b) For the circuit shown in Fig. for Q. No. 7(b) determine the value of I_x using source transformation. **(20)**

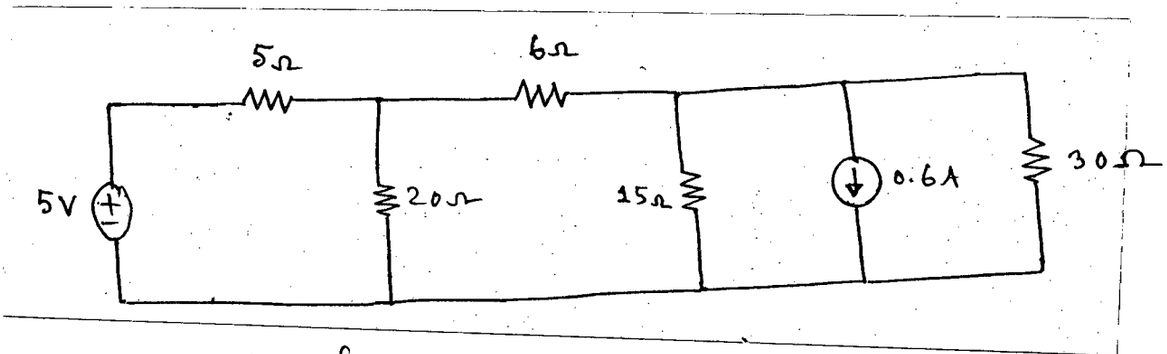

Fig. for Q. No. 7(b)

Contd P/2

EEE 167/IPE

8. (a) For the circuit shown in Fig. for Q. No. 8(a) determine the value of V_s if current through the 6 Ω resistor is 1 A. **(26⅔)**

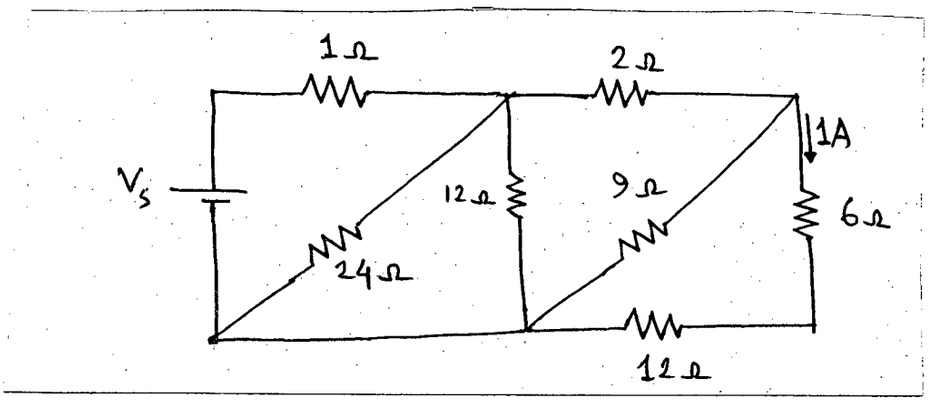

Fig. for Q. No. 8 (a)

(b) For the circuit shown in Fig. for Q. No. 8(b), determine the value of I_x, I_y and I_z. **(20)**

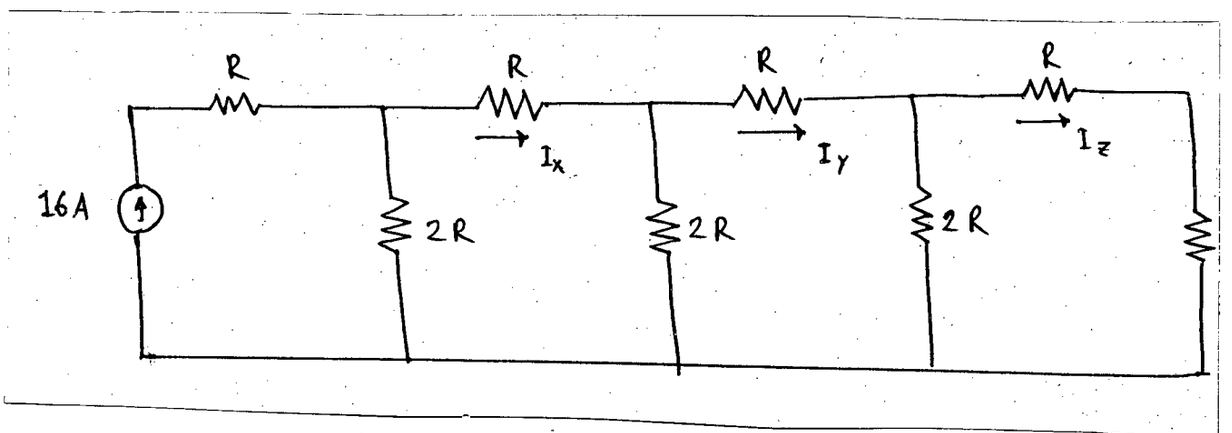

Fig. for Q. No. 8 (b)

L-1/T-2/IPE **Date : 06/07/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **MME 195** (Engineering Materials 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) Draw a thermal equilibrium diagram (on a piece of graph paper) for metals A and B having melting points of 327°C and 232°C, respectively. They are mutually soluble in liquid state but partially soluble in solid state. At 183°C a eutectic composition is formed with 62% B and 38% A. At eutectic temperature the solubility of B in A is 18.3% and that of A in B is 2.2%, while at room temperature the solubility B in A is 6% and that of A in B is 1%. Solid solution of B in A is known as α phase and that of A in B is known as β phase. (15)

   From phase diagram, Sketch the microstructures of alloys containing 10%, 40% and 70% B and rest A, after they have been cooled slowly to room temperature. (10)

   Also calculate the relative amount of each phase present in terms of mass fraction at room temperature for an alloy containing 60 wt% A and 40 wt% B. (10)

2. (a) How nodular cast iron differ from malleable cast iron? Briefly describe the method of producing malleable cast iron from white cast iron. (20)

   (b) Explain the order of elimination of impurities in 'Basic Oxygen Process' of steel making with the help of a refining diagram. (15)

3. (a) Describe various reactions that occur in stack, bosh and hearth region of a blast furnace. (20)

   (b) "Complete refinement of Si, P and Mn is not possible in Blast furnace" – Explain the statement. (5)

   (c) Write down the effects of silicon, sulfur, Manganese and Phosphorous content on cast iron. (10)

4. (a) What is the driving force behind Galvanic corrosion and how this type of corrosion can be prevented? (10)

   (b) "Whether tinning or galvanization is more suitable for corrugated steel sheet roofing in domestic use?" – Give reasoning. (10)

   (c) Mention common casting defects with their possible remedies. (15)

Contd P/2

MME 195

SECTION-B

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

5. (a) What do you understand by coordination number? With the help of labelled diagrams calculate the atomic packing factor of a FCC crystal structure. (20)
   (b) State the limitations of plain carbon steels. (10)
   (c) What is the principal advantage of Ni-steels? (5)

6. (a) Sketch the microstructures, calculate the relative phase fractions and approximate tensile strengths of 0.2% and 1.2% carbon steels when there are very slowly cooled from austenite range to room temperature. (20)
   (b) With the help of microstructures state the differences between normalized and annealed hyper eutectoid steels. (15)

7. (a) Compare and contrast among (i) White cast iron (ii) pearlitic and ferritic gray cast iron (iii) pearlitic malleable cast iron (iv) ferritic ductile iron in terms of microstructure, composition and heat treatment. (25)
   (b) What are the materials that are commonly used to make actuators? (10)

8. (a) With the help of labelled diagrams, state the sequence of steps leading to cup-and-cone fracture. (15)
   (b) What are the different kinds of stainless steels? (10)
   (c) What do you understand by ductile-to-brittle transition? (10)

L-1/T-2/IPE **Date : 01/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **MATH 193** (Vector, Matrix and Co-ordinate Geometry)

Full Marks: 280 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**.

Symbols used have their usual meaning.

1. (a) Show that the three vectors $2\underline{i}+\underline{j}-3\underline{k}$, $\underline{i}-4\underline{k}$ and $4\underline{i}+3\underline{j}-\underline{k}$ are linearly dependent. Determine a relation among them and hence show that the terminal points are co-llinear. **(15)**

   (b) Show that four points whose position vectors are $3\underline{i}-2\underline{j}+4\underline{k}$, $6\underline{i}+3\underline{j}+\underline{k}$, $5\underline{i}+7\underline{j}+3\underline{k}$, $2\underline{i}+2\underline{j}+6\underline{k}$ are co-planar. **(15)**

   (c) For three vectors $\underline{a}, \underline{b}, \underline{c}$, prove that $\underline{a}\times(\underline{b}\times\underline{c})=(\underline{a}.\underline{c})\underline{b}-(\underline{a}.\underline{b})\underline{c}$. **(16⅔)**

2. (a) Using vectors, prove that the diagonals of a parallelogram bisect each other. **(15)**

   (b) Express $[\underline{a}\ \underline{b}\ \underline{c}][\underline{d}\ \underline{e}\ \underline{f}]$ in the form **(15)**

$$\begin{vmatrix} \underline{a}.\underline{d} & \underline{a}.\underline{e} & \underline{a}.\underline{f} \\ \underline{b}.\underline{d} & \underline{b}.\underline{e} & \underline{b}.\underline{f} \\ \underline{c}.\underline{d} & \underline{c}.\underline{e} & \underline{c}.\underline{f} \end{vmatrix}$$

   (c) A line makes angles $\alpha, \beta, \gamma, \delta$ with the diagonals of a cube **(16⅔)**

   prove that $\cos^2\alpha+\cos^2\beta+\cos^2\gamma+\cos^2\delta=\frac{4}{3}$.

3. (a) Find the inverse of the matrix, $A=\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 6 \\ 3 & 4 & 5 & 7 \\ 4 & 5 & 5 & 7 \end{bmatrix}$ by using only row transformation

   to reduce A to I. **(16⅔)**

   (b) Find the non-singular matrices P and Q such that PAQ is in the normal form, when **(15)**

$$A=\begin{bmatrix} 1 & 3 & -1 & 3 \\ 3 & 4 & -3 & 4 \\ 1 & 3 & 1 & 2 \end{bmatrix}$$

Contd P/2

MATH 193/IPE

Contd... Q. No. 3

(c) Investigate for what values of λ and μ, the following system of equations **(15)**

$$x+y+z=6$$
$$x+2y+3z=10$$
$$x+2y+\lambda z=\mu$$

have (i) unique solution (ii) no solution and (iii) many solutions.

4. (a) Reduce the real quadratic form $q=x_1^2-2x_2^2+3x_3^2-4x_2x_3+6x_1x_3$ to the canonical form. Also find the index, signature of the quadratic form and the corresponding equations of transformation. **(20⅔)**

(b) State and prove Cayley-Hamilton theorem. Verify above theorem for the matrix **(26)**

$$A=\begin{bmatrix}1 & 2 & 3\\ 2 & -1 & 1\\ 3 & 1 & 1\end{bmatrix}.$$

Since A is non-singular, using the above theorem compute A^{-1}, A^{-2} and A^4.

SECTION – B

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

5. (a) Transform the equation $5x^2-24xy-5y^2+4x+58y-59=0$ in rectangular coordinates using suitable translation and rotation of axes so as to remove the terms in *x, y* and *xy*. Then identify the conic. **(23)**

(b) Find the angle between two lines whose direction cosines are given by the equations $l+m+n=0$ and $2lm+2ln-mn=0$. **(23⅔)**

6. (a) Show that the lines whose direction cosines are given by the relations $al+bm+cn=0$, $ul^2+vm^2+wn^2=0$ are perpendicular if **(23)**

$u(b^2+c^2)+v(c^2+a^2)+w(a^2+b^2)=0$ and parallel if $\frac{a^2}{u}+\frac{b^2}{v}+\frac{c^2}{w}=0$.

(b) A plane meets the coordinate axes in A, B, C such that the centroid of triangle ABC is the point (p, q, r). Show that the equation of the plane is $\frac{x}{p}+\frac{y}{q}+\frac{z}{r}=3$. **(23⅔)**

Contd P/3

MATH 193/IPE

7. (a) Find the shortest distance between the lines **(23⅔)**

$$\frac{x-3}{3}=\frac{y-8}{-1}=\frac{z-3}{1} \text{ and } \frac{x+3}{-3}=\frac{y+7}{2}=\frac{z-6}{4}.$$

Find also the equation of SD line and points in which it meets the given lines.

(b) Find the equation of line drawn parallel to $\frac{x}{3}=\frac{y}{2}=\frac{z}{-1}$ so as to intersect the lines $2x-5y-3z+2=0=3x-4y+2z+1$ and $x+2y-7=0=z+3$. **(23)**

8. (a) Find the coordinates of the centre and radius of the circle **(23)**

$$x+2y+2z=15,\ x^2+y^2+z^2-2y-4z=11.$$

(b) A plane passes through a fixed point (*a, b, c*) and cuts the axes in A, B, C. Show that the locus of the centre of sphere OABC is $ax^{-1}+by^{-1}+cz^{-1}=2$. **(23⅔)**

L-1/T-2/IPE **Date : 05/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **CHEM 143** (Chemistry of Materials)

Full Marks: 140 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) How would you classify the polymer on the basis of the following important points of view? **(12)**

(i) Backbone chain (ii) Mechanical properties (iii) Degree of polymerization (iv) Polarity.

(b) Discuss the addition polymerization, condensation polymerization and ring opening polymerization with suitable chemical equations. **(6 ⅓)**

(c) Write the structural formula of the following polymers. **(5)**

(i) plastic polymer (ii) co-polymer (iii) stereospecific polymer (iv) Heterochain inorganic polymer (v) Resin polymer

2. (a) Describe the stepwise mechanism of the free radical addition polymerization process. **(5 ⅓)**

(b) Write down the structures of the co-polymers from the following pairs of monomer. **(5)**

(i) $CH_2 = CH_2,\ F_2C = CF_2$

(ii) $H_2N-(CH_2)_6-NH_2, HOOC-(CH_2)_4-COOH$

(iii) $HO-CH_2-CH_2-OH, CH_3OOC-C_6H_4-COOCl_3$

(iv) $C_6H_5-CH=CH_2, CH_2=CH-CH=CH_2$

(v) $CH_2=CHCl, CH_2=CH-CH=CH_2$

(c) What are the functions of the following additives which are generally used to convert polymer into suitable articles. **(8)**

(i) Binders (ii) Fillers (iii) Plasticizers (iv) Lubricants

(d) Discuss the industrial manufacturing process of Teflon. **(5)**

3. (a) Describe the synthesis and industrial applications of the following plastic polymers. **(10)**

(i) PVC (ii) Nylon 6, 6 (iii) Melamine (iv) Bakelite

(b) Plastics are polymer but all polymers are not plastic— Explain the statement. **(4**

(c) What are the requirements of fiber which are every much important as an engineering material? **(4 ⅓)**

(d) Describe the industrial manufacturing process of LDPE. **(5)**

Contd P/2

CHEM 143/IPE

4. (a) How would you classify the rubber based on the sources? Discuss the process of collection of rubber from bushy plants. **(3 ⅓)**

   (b) Describe the chemical substances which are usually used in compounding and their effect on the properties of rubber. **(7)**

   (c) Discuss the synthesis and industrial applications of the following rubbers. **(08)**

   (i) SBR (ii) Thiokol (iii) Silicon rubber (iv) Spandex

   (d) Describe the industrial manufacturing process of neoprene rubber. **(5)**

SECTION – B

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

5. (a) Point out the detrimental effects friction. **(5 ⅓)**

   (b) What are the objectionable impurities present in lubrication oil of mineral origin? **(5)**

   (c) Discuss the dewaxing process of lubrication oil. **(5)**

   (d) Write short notes on any two of the following. **(4×2=8)**

   (i) Viscosity and viscosity index
   (ii) Flash point and fire point
   (iii) Oxidation stability of lubricating oils.

6. (a) What is direct chemical corrosion? Give the classification of direct chemical corrosion. **(5)**

   (b) Discuss the economic aspects of corrosion. **(5)**

   (c) What do you mean by the term "Threshold value" of humidity? Classify atmosphere on the basis of marked differences in corrosion. **(2+6=8)**

   (d) How would you prevent corrosion? **(5 ⅓)**

7. (a) State the salient properties that made glass a valuable structural material in modern civilization. **(6)**

   (b) Discuss the major phases involved in obtaining a finished glass article. **(6)**

   (c) Describe the furnaces used for melting during the manufacture of glass materials. **(6)**

   (d) Write with reactions the melting of the batch material when it is composed of red lead, potassium carbonate and silica as its components. **(5 ⅓)**

8. (a) What is varnish? Mention the constituents with examples used for the manufacture of varnish. **(6 ⅓)**

   (b) What are driers and antiskinning agents of paint? Give their uses and functions. **(6)**

   (c) Describe the failure of paints and how it can be prevented. **(6)**

   (d) Write a short note on enamel paint. **(5)**

L-1/T-2/IPE **Date : 09/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **PHY 163** (Waves and Oscillations, Physical Optics and Wave Mechanics)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Describe a physical phenomenon that can be explained only in terms of Quantum Mechanics. **(7)**

   (b) Deduce the Schrödinger wave equation for a free particle moving in a field of constant potential v_0. **(15)**

   (c) State de-Broglie hypothesis. Derive the infinite square well energy quantization law directly from the de-Broglie relation $P = h/\lambda$, by fitting an integral number of half de-Broglie wavelengths $\lambda/2$ into the width 'a' of the well. **(13)**

2. (a) Write down the required characteristics of wavefunction Ψ. **(5)**

   (b) Explain the energy eigenfunction of an electron that is strongly bound to its atomic nucleus. Draw schematically the allowed energy levels for different n-values. **(15)**

   (c) Explain 'Quantum Mechanical Tunneling' effect and write down its important applications in Solid State Physics. **(15)**

3. (a) Write down some fundamental postulates of Statistical Mechanics. **(05)**

   (b) Briefly describe the three statistical distribution functions. Show schematically their comparison considering that the functions give the probability of occupancy of a state of energy ε at the absolute temperature T. **(20)**

   (c) Find the r.m.s. speed of oxygen molecules at $0^{\circ}C$. Show schematically the distribution of molecular speeds in oxygen at 73 K and also at 273 K. **(10)**

4. (a) What is simple harmonic motion? Write down its differential equation and solve it. **(15)**

   (b) Show that the resultant of two oscillations given by $x_1 = a_1 \cos(wt + \phi_1)$ and $x_2 = a_2 \cos(wt + \phi_2)$ is also simple harmonic and deduce an expression for resultant amplitude. What happens if the two vibrations are in opposite phase with their amplitudes being equal? **(15)**

   (c) Two simple harmonic oscillations acting simultaneously on a particle are given by the equations $y_1 = 3\sin wt$ and $y_2 = 4\sin(wt + \phi)$ in C.G.S. unit. Calculate resultant amplitude when (i) $\phi = \pi/3$ and (ii) when $\phi = 0$. **(5)**

Contd P/2

PHY 163/IPE

SECTION – B

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

5. (a) What are the differences between a progressive wave and a stationary wave? **(6)**

(b) Discuss analytically the formation of stationary wave due to reflection (i) at a rigid boundary and (ii) at a free boundary. What are nodes and antinodes? Show that at the position of antinode strain is minimum. **(24)**

(c) The fixed supports of a nylon guitar string are 90 cm apart. The string is oscillating as a three loop standing wave pattern. Calculate the wave length. How many nodes are produced? **(5)**

6. (a) Define reverberation and reverberation time. What are the characteristics of a good auditorium? **(9)**

(b) By using Sabine's assumptions show that the intensity of sound in a room increases exponentially. Deduce an expression for reverberation time. **(16)**

(c) A room has dimension $12 \times 8 \times 10$ in meters. It's reverberation time is 1 second. What is the total absorbing power of all the surface of the room? Calculate the number of reflection per second. Velocity of sound is 330 m/sec. **(10)**

7. (a) What are coherent sources? How are they realized in practice? **(4+4=8)**

(b) Describe Fresnel's biprism. Explain how the wavelength of light can be determined with the help of a biprism. **(8+10=18)**

(c) In Fresnel's biprism experiment, on inserting a thin glass plate in the path of the interfering beam, it is found that the central bright fringes shifts into the position previously occupied by the 6th bright fringe. If the wavelength of the light used is 6×10^{-5} cm and the refractive index of the glass plate is 1.5 for this wavelength, calculate the thickness of the plate. **(9)**

8. (a) Explain what is meant by diffraction spectra of different orders and state the condition under which the grating spectra of even order are absent. **(10)**

(b) Light is incident normally on a grating 0.5 cm wide with 2500 lines. Find the angles of diffraction for the principal maxima of the two sodium lines (λ_1 = 5890 Å and λ_2 = 5896 Å) in the first order spectrum. **(10)**

(c) Explain plane of vibration and plane of polarization with figure. **(3+3=6)**

(d) Explain how a nicol prism can be used as a polarizer. **(9)**
