L-1/T-2/BME **Date: 15/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2020-2021

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) Explain why the two layers of the cerebral cortex have different colors. **(7)**

   (b) How can you measure the internal pressure of the CSF? **(7)**

   (c) Draw the layers and spaces of the meninges. What are the functions of these layers? **(10)**

   (d) Write the origin and the circulation of the CSF. What would happen if the circulation is blocked, and how can this condition be treated? **(11)**

2. (a) State the functions and types of cranial nerves associated with the eye and taste. **(12)**

   (b) How the taxi drivers in London achieved brains of bigger size? **(5)**

   (c) What is enthesis? Write the name of the major muscles at the abdomen wall, upper extremity, and lower extremity. **(13)**

   (d) Identify the differences between tendon and ligament. **(5)**

3. (a) Write down the name and numbers of axial and appendicular skeleton bones to prove that an adult human has 206 bones. **(15)**

   (b) Draw and identify different parts of the sternum. How can we classify ribs based on their attachment to it? **(7)**

   (c) How can we extract organic and inorganic components of a bone? **(5)**

   (d) Explain the structure and function of different coverings of skeletal muscle by drawing a schematic. **(8)**

4. (a) Using a schematic, explain the "9+0 arrangement" of centriole and the "9+2 arrangement" of flagella. How many microtubules are there is each case? **(7)**

   (b) Suppose a protein has been synthesized at organelle "X". It will then move to "Y" and then to "Z" before getting out of the cell via exocytosis of secretory granules. **(18)**

   (i) Identify "X", "Y", and "Z" and explain why so.

   (ii) Explain the trajectory of this protein movement with a neat diagram.

   (iii) How is the secretory granule formed?

   (c) Write down the functions of the intermediate filament. Explain the structure of the nuclear envelope with a schematic and identify the intermediate filament commonly found near the nuclear pore complex. **(10)**

Contd P/2

BME 103

SECTION – B

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

5. (a) What does "natural pacemaker" mean? Draw and label the cardiac conducting system. **(4+7=11)**

(b) Explain how pressure within the eye is maintained. Describe the differences between the Jejunum and Ileum. **(4+5=9)**

(c) Write briefly on- **(5×3=15)**

(i) Working steps of Lymphatic system
(ii) Classification of Pharynx
(iii) Root of the lungs

6. (a) A scientist develops a medication known as T5x. It is impermeable to the membrane of Bowman's capsule, although its residues can be detected in patient urine. How does it come to urine? Briefly discuss about the part of the nephron that is responsible for it? **(7)**

(b) What is stomach bed? Draw and label the structure of the stomach. **(4+6=10)**

(c) Differentiate between peptide hormone and steroid hormone. Name the hormones of the temporary endocrine gland of female. **(4+2=6)**

(d) Write the contents of (i) Outer ear, (ii) Middle ear. Explain why auditory tube opens into the pharynx. **(4×3=12)**

7. (a) Suppose you have been exercising for a long time. As a result, your body needs a greater supply of oxygen. As a BME student, you are aware that some additional muscles help with your breathing at this stage. Make a list of those muscles? **(7)**

(b) What is sclera? Draw and label the structure of the eye. **(4+6=10)**

(c) Name the different refractive medias of the eyeball and describe their significance. **(4+2=6)**

(d) Write the contents of (i) Male pelvis cavity, (ii) Abdomen cavity. Write down the name of different parts of the heart valve complexes. **(4×3=12)**

8. (a) Consider a patient who comes to the Sheikh Hasina National Institute of Burn and Plastic Surgery with serious burns. According to the on-duty physician, the patient's injuries extended to the middle layer of skin. Describe the skin functions you believe are impacted by this injury. **(5)**

(b) What is Renal sinus? Draw and label the microscopic structure of kidney. **(4+6=10)**

(c) How does the vertical dimension of the lung increase? Differentiate between Type I pneumocyte and Type II pneumocyte. **(4+4=8)**

(d) Write briefly on- **(4×3=12)**

(i) Constrictions of oesophagus
(ii) Importance of Bronchopulmonary segment
(iii) Organ of Male and Female reproductive system

L-1/T-2/BME **Date: 19/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2020-2021

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

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Symbols have their usual meaning

USE SEPARATE SCRIPTS F`OR EACH SECTION

SECTION – A

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

1. (a) If the imaginary part of $\frac{(2z+1)}{(iz+1)}$ is –2 then show that the locus of the points representing in the argand plane is a straight line **(10)**

(b) Compute the principal value of Ln z for $z = 1+i$. **(10)**

Also show that $|\cos z|^2 = \cos^2 x + \sinh^2 y$ for all complex numbers $z = x+iy$.

(c) Determine whether the following function $f(z)$ are entire or not. Justify your answer. Also find the complex derivative $f'(z)$ if $f(z)$ is entire. **(15)**

(i) $f(z) = \frac{1}{1+|z|^2}$ (ii) $f(z) = 2^{(3^z)}$.

2. (a) Write down Cauchy-Riemann equations in polar form. Test the differentiability of the function **(15)**

$$f(z) = \frac{1}{r^4}\cos 4\theta + i\left(-\frac{1}{r^4}\sin 4\theta\right), \quad r > 0, \quad 0 < \theta < 2\pi$$

and hence show that $f'(z) = -\frac{4}{r^5 e^{i5\theta}}$.

(b) Show that $u(x,y) = e^{-x}(x\sin y - y\cos y)$ is a harmonic function. Find an analytic function $f(z) = u(x,y) + iv(x,y)$ and express $f(z)$ in terms of z. **(20)**

3. (a) Evaluate $\int |z|^2 dz$ along the curve $x = t^2, y = \frac{1}{t}$, $1 \le t \le 2$. **(10)**

(b) Use Cauchy integral formula to evaluate $\oint_C \frac{\sin z}{z^2+\pi^2} dz$, where the contour C is the circle $|z-2i| = 2$. **(10)**

(c) Expand $f(z) = \frac{z}{(z-1)(2-z)}$ in a Laurent series valid for $1 < |z| < 2$. Also identify the singularity. **(15)**

4. (a) Use Cauchy Residue theorem to evaluate $\frac{1}{2\pi i}\oint_C \frac{e^{zt}}{z^2(z^2+2z+2)} dz$ **(15)**

along the contour $C: |z| = 3$.

(b) Using the method of contour integration evaluate $\int_0^{2\pi} \frac{d\theta}{(2+\cos\theta)^2}$. **(20)**

Contd P/2

SECTION – B

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

5. (a) Find the tangential and normal components of acceleration at time $t = 1$ of the given position vector function $\vec{r} = t\hat{i} + t^2\hat{j} + t^3\hat{k}$. **(10)**

(b) Calculate the curvature of the curve with position vector $\vec{r} = a\cos t\,\hat{i} + b\sin t\,\hat{j}$, where a and b are constants. Interpret the case where $a = b$. **(15)**

(c) Find the value of p such that divergence of $\vec{F} = \frac{\vec{r}}{r^p}$ is zero. **(10)**

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

(b) Find the most general differentiable function $f(r)$ so that $f(r)\vec{r}$ is solenoidal. **(11)**

(c) Show that $\vec{E} = \frac{\vec{r}}{r^2}$ is irrotational. Find ϕ such that $\vec{E} = -\vec{\nabla}\phi$ and such that $\phi(a) = 0$, where $a > 0$. **(12)**

7. (a) Evaluate $\int_C \vec{A}\cdot d\vec{r}$ along the curve $x^2 + y^2 = 1$, $z = 1$ in the positive direction from (0, 1, 1) to (1, 0, 1) if $\vec{A} = (yz + 2x)\vec{i} + xz\vec{j} + (xy + 2z)\vec{k}$. **(18)**

(b) If $\vec{F}(x, y, z) = (2x^2 - 3z)\hat{i} - 2xy\hat{j} - 4x\hat{k}$, evaluate $\iiint_V div\,\vec{F}\,dV$, where V is the closed region bounded by the planes $x = 0$, $y = 0$, $z = 0$ and $2x + 2y + z = 4$. **(17)**

8. (a) Given a force field $\vec{F}(x, y) = (y - \sin x)\hat{i} + \cos x\,\hat{j}$. Using Green's theorem calculate the work done in moving a particle in this force field along a triangular path with vertices (0, 0), (π/2, 0) and (π/2, 1). **(12)**

(b) Verify the divergence theorem for $\vec{A}(x, y, z) = 4x\,\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ taken over the region bounded by $x^2 + y^2 = 4$, $z = 0$ and $z = 3$. **(23)**

L-1/T-2/BME Date : 03/11/2022

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2020-2021

Sub : **CHEM 147** (Organic 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) Which of the following alkanes has the ability to exhibit optical activity and why? **(10)**

(i) Neopentane (ii) Isopentan

(iii) 3-methylpentane (iv) 3-methylhexane

Draw the enantiomers of the compound and label them as (R) and (S).

(b) Define conformations of molecules. By drawing Newman projection formulas, show how do the potential energy changes occur in n-butane when the molecule is rotated around its C_2-C_3 bond axis through a complete cycle. Discuss the stability of the conformational isomers. **(15)**

(c) An alkyl halide A ($C_6H_{13}Cl$) on treatment with potassium tert butoxide gives two isomeric alkenes B and C (C_6H_{12}). Both alkenes on hydrogenation give 2, 3-dimethyl butane. Predict the structures of A, B and C. **(10)**

2. (a) What stereoisomers would be obtained from hydroboration-oxidation of the following compounds? Give the reactions. **(10)**

(i) 1, 2-dimethylcyclopentene

(ii) 1-ethylcyclohexene

(b) Draw the structures of the following compounds. For each pair of compounds, predict the one with a higher boiling point and explain the reasons. **(10)**

(i) cis-2-butene and trans-2-butene

(ii) cis-1, 2-dichloroethene and trans-1, 2-dichloroethene

(c) How will you synthesize 3, 3-dimethyl-2-butanol from 3, 3-dimethyl-1-butene? Discuss the mechanism. **(15)**

3. (a) Explain the followings: **(10)**

(i) Vinyl chloride is unreactive towards nucleophilic substitution reactions.

(ii) $(CH_3)_2$ CH CH_2Cl is very unreactive towards nucleophiles.

(b) Determine the degree of unsaturation, and then draw possible structures of the compound, C_3H_6. How will you synthesize primary and secondary alcohols from the compound? Discuss with mechanisms. **(15)**

Contd P/2

CHEM 147/BME

Contd ... Q. No. 3

(c) Give the major product(s) of the reaction of 1-methylcyclohexene with the following reagents, ignoring stereoisomers: **(10)**

(i) NBS/Δ/peroxide

(ii) Br_2/CH_2Cl_2

(iii) HBr/peroxide

Draw the configurations of the products.

4. (a) What do you understand by 'Gilman reagent'? Using 'Gilman reagent' how will you synthesize 2, 2-dimethylpropane? Discuss with mechanism. **(15)**

(b) Define polar protic and polar aprotic solvents. Does S_N^1 prefer protic or aprotic solvents? Explain your answer with an example. **(10)**

(c) Prepare tert-butyl ethyl ether by Williamson ether synthesis. Discuss the mechanism. **(10)**

SECTION – B

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

5. (a) Identify the factors that determine nucleophilic aromatic substitution. Discuss the mechanism of the nucleophilic aromatic substitution of nitrochlorobenzenes with hydroxide ion at high temperature. **(15)**

(b) Predict the products of the following reactions and explain the formation of products with mechanism. **(20)**

(i) Nitration of toluene (ii) Nitration of benzaldehyde

6. (a) Are thiophene and imidazole aromatic? Draw orbitals to explain your answer. **(10)**

(b) Pyrrole undergoes electrophilic substitution at C-2 or C-5 position. Illustrate the reason. **(10)**

(c) Explain with an energy diagram why substitution is favored over addition during bromination of benzene. **(10)**

(d) Show the formation of *o*-nitroaniline from acetanilide by reactions only. **(5)**

7. (a) Electron donating and electron withdrawing groups affect the rate of an electrophilic aromatic substitution reaction. Justify the statement with transition state and free energy diagram. **(10)**

(b) Starting with benzene, outline a synthesis of each of the followings: **(20)**

(i) *m*-Dinitrobenzene (ii) *o*-Chloronitrobenzene

(ii) *tert*-Butylbenzene (iv) *p*-Bromonitrobenzene

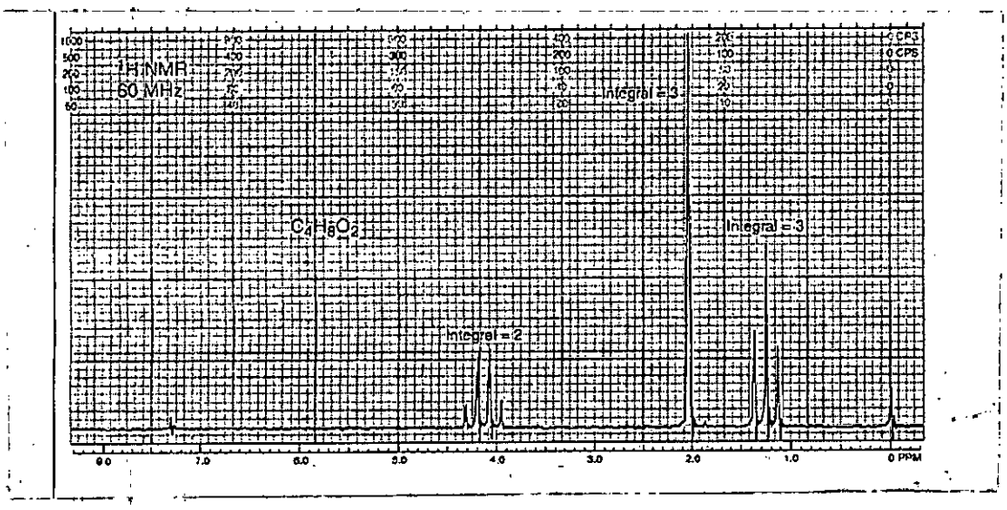
(c) Discuss the criteria for a compound to absorb IR radiation. **(5)**

Contd P/3

CHEM 147/BME

8. (a) Sketch the ^{1}H-NMR spectrum of propyl bromide and ethyl alcohol with appropriate splitting patterns and integrations. **(20)**

(b) The following compound, with the formula $C_4H_8O_2$, is an ester. Interpret its structure and assign the chemical shift values. **(10)**



(c) Write down the reasons for using tetramethyl silane (TMS) as an internal standard in NMR spectroscopy. **(5)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2020-2021

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

The symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) The voltage across and current through a circuit element are shown in the Fig. for Q. 1(a). Sketch the power versus t plot for $0 \le t \le 10$ s. Also, calculate the energy delivered to the element in 10 s. **(15)**

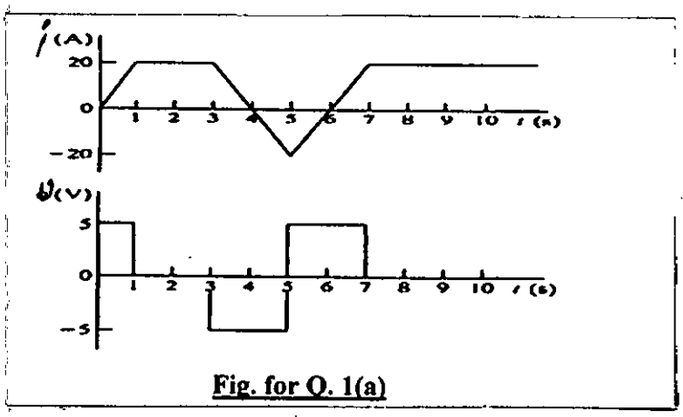


Fig. for Q. 1(a)

(b) Find the resistance R_{ab} in the figure shown in Fig. for Q. 1(b). **(15)**

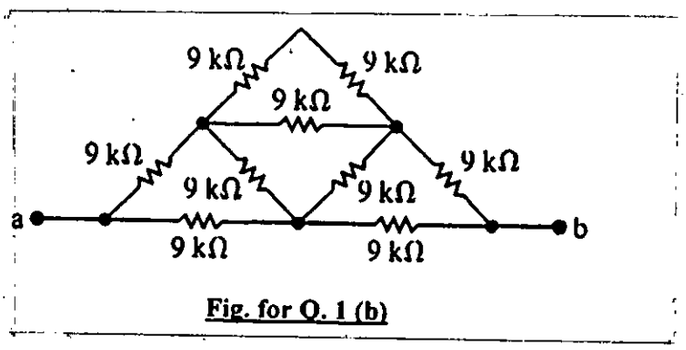


Fig. for Q. 1 (b)

(c) Distinguish between ideal and actual voltage sources. **(5)**

Contd P/2

EEE 171/BME

2. (a) The variable resistor R in the circuit shown in Fig. for Q. 2(a) is adjusted until v_a equals 60 V. Find the value of R. **(15)**

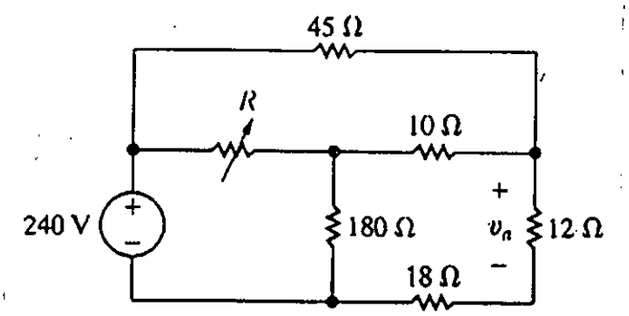


Fig. for Q. 2(a)

(b) Use Thevenin's theorem to find V_0 in the circuit shown in Fig. for Q. 2(b). **(15)**

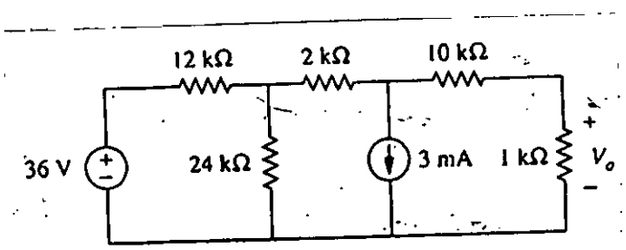


Fig. for Q. 2(b)

(c) State and explain superposition principle. **(5)**

3. (a) Compute the value of R that results in maximum power transfer to the 10 Ω resistor in the circuit shown in Fig. for Q. 3(a). Find also that maximum power. **(15)**

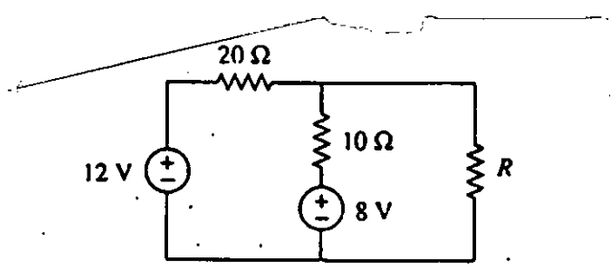


Fig. for Q. 3(a)

Contd P/3

EEE 171/BME

Contd ... Q. No. 3

(b) The variable DC source in the circuit shown in Fig. for Q. 3(b) is adjusted so that i is zero. Find the value of V_{dc}. **(15)**

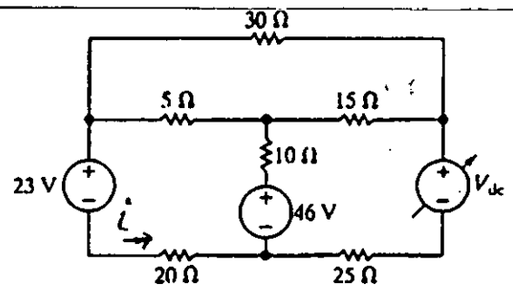


Fig. for Q. 3(b)

(c) Define magnetic induction in a coil. Draw and explain magnetization curve of a ferromagnetic material. **(5)**

4. (a) In the circuit shown in Fig. for Q. 4(a), $v(t) = 10e^{-3t}$ V for $t > 0$ and $i_1(0) = 10$ A. Find $i_1(t)$ and $i_2(t)$. **(15)**

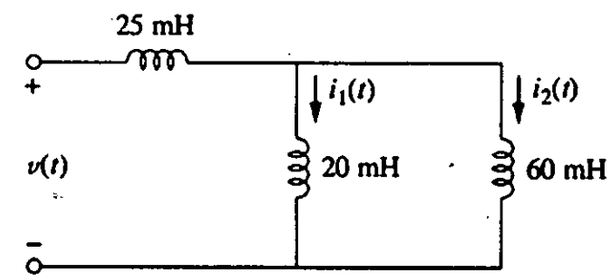


Fig. for Q. 4(a)

(b) Use mesh-current method to find the power dissipated in the 1 Ω resistor in the circuit shown in Fig. for Q. 4(b). **(15)**

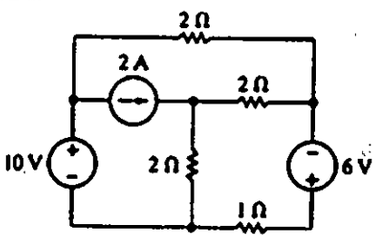


Fig. for Q. 4(b)

(c) Define capacitor and inductor, and write their main properties. **(5)**

Contd P/4

EEE 171/BME

SECTION – B

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

5. (a) Consider the circuit shown in the Fig. for Q. No. 5(a). Using necessary AC circuit analysis techniques, calculate the time domain expression of the current flowing through the capacitor. **(20)**

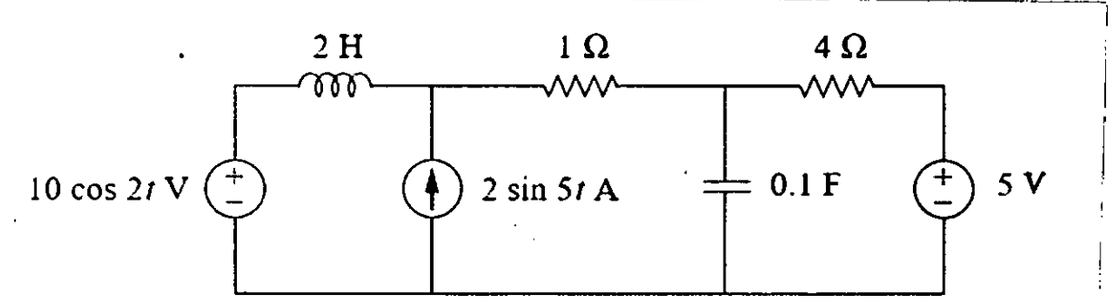


Figure for Question no. 5(a)

(b) Derive the expression of average power supplied by a sinusoidal source in an R-L-C circuit. Also show the phasor diagram for this circuit indicating the voltage appearing across each elements of this circuit. According to your diagram, is the power factor of the circuit leading or lagging? Why? **(15)**

6. (a) Derive the condition of maximum power transfer for an AC load having load impedence of $Z_{Load} = R_{Load} + j X_{Load}$. Apply your derivation to calculate the load impedence Z_L in the circuit shown in Fig. for Q. No. 6(a) so that maximum power is transferred to this load. **(20)**

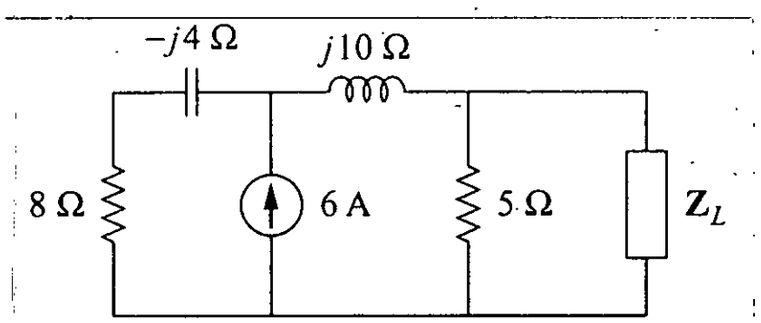


Figure for Question no. 6(a)

(b) Show how you can design Band-pass and Band-reject filters using R-L-C circuits. Is it possible to design these filters using Low-pass and High-pass filters? How? **(15)**

Contd P/5

EEE 171/BME

7. (a) Consider the parallel resonant circuit shown in Fig. for Q. No. 7(a) which has R = 10 kΩ, L = 0.1 mH, C = 10 μF. For the sinusoidal input shown in this circuit, calculate the (i) quality factor, (ii) resonant frequency, (iii) bandwidth, and (iv) cut-off frequencies. Also qualitatively draw the input impedence of this circuit as a function of frequency and suggest a possible application of this circuit based on this frequency response. **(20)**

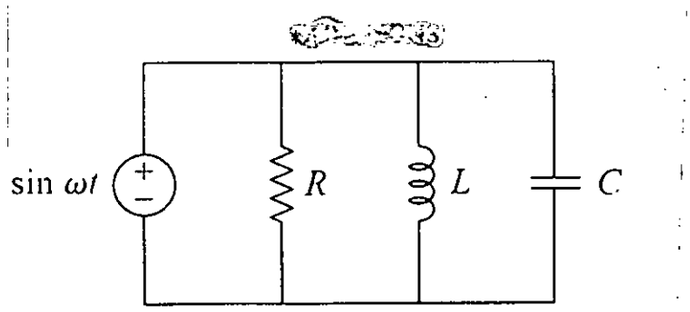


Figure for Question no. 7(a)

(b) Consider a balanced 3-phase system which has a Y-connected generator and a Δ-connected inductive load. Considering a-b-c phase sequence, show the relations between phase and line voltages, and also phase and line currents at the load end. With necessary circuit diagram, suggest a technique of measuring the total power consumed by this 3-phase load. **(15)**

8. (a) What do you understand by coefficient of coupling in a magnetically coupled circuit? For the circuit shown in Fig. for Q. No. 8(a) calculate the current flowing through the 2 Ω resistor. Also calculate the coefficient of coupling for this circuit. **(20)**

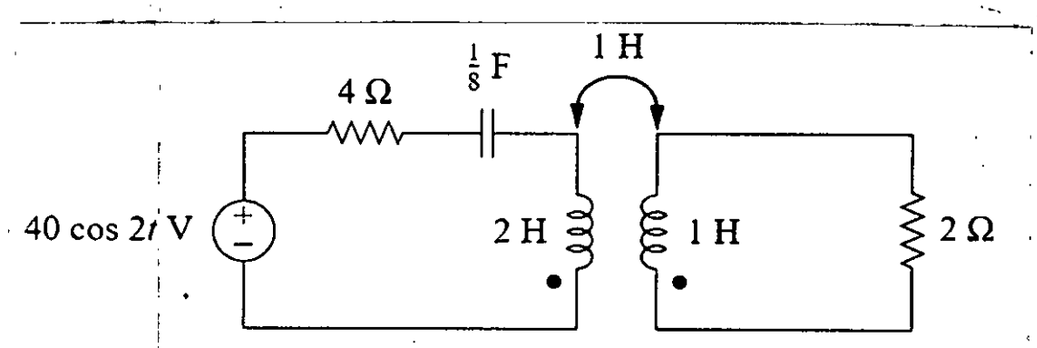


Figure for Question no. 8(a)

Contd P/6

EEE 171/BME

Contd ... Q. No. 8

(b) Consider the balanced 3-phase system shown in Fig. for Q. No. 8(b) where load impedence in each phase is 20 – 5j and the voltage V_{ab} = 230 V. Assuming a-c-b phase sequence, calculate the total real, reactive and complex power consumed by the 3-phase load. Also calculate the power factor for this load. **(15)**

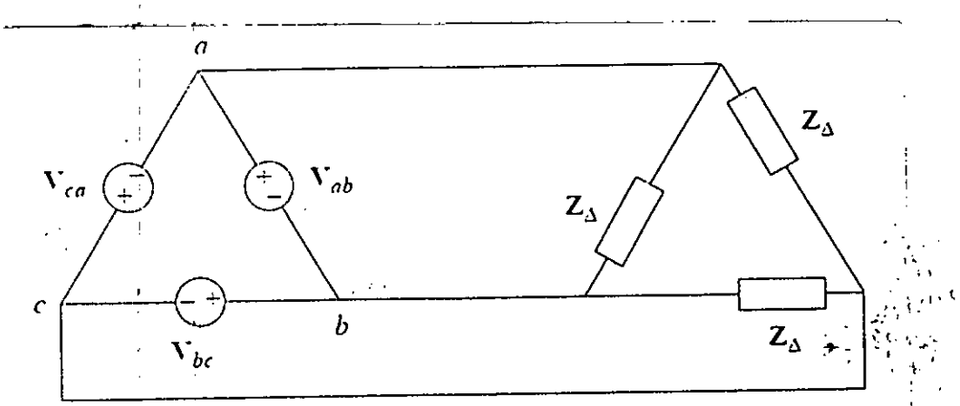


Figure for Question no 8(b)
