L-1/T-2/WRE   Date: 24/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
L-1/T-2 B.Sc. Engineering Examinations January 2020 (Online)

Sub: **WRE-103** (Surveying)

Full Marks: 180   Time: 2 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 qualitative contour maps for the following natural features: **(6)**

    (i)   Overhanging Cliff

    (ii)   Vertical Cliff

  (b) The following readings were taken while levelling along the central line **(24)** of a proposed road. It was decided to keep the formation level of the road 2 ft above the reduced level (RL) at the starting point (zero chainage) and the road to have a falling gradient of 1 in 100. At the point of 800 chainage a Bench Mark of RL = (600+ **Last Two Digits of Your Student ID**) ft was found. Enter the readings in a field level book and find the RL and formation levels for all the stations. Use rise and fall method.

Chainage (ft)	Staff Reading (ft)	Chainage (ft)	Staff Reading
0	6.50	500	3.50
100	7.40	600	8.50
200	7.70	700	6.40
300	8.90	800	7.80
400	9.10	900	8.60
500	12.00	1000	11.50

2. Calculate the Area of the following traverse: (30)

Side	Length (ft)	WCB
AB	265 + Last two digits of your Student ID	342° 48'
BC	260	36° 15' 30"
CD	220	83° 21'
DE	280	148° 53'
EF	320	204° 28'
FA	300	274° 28'

3. (a) The following perpendicular offsets were taken from a chain line to a (8) hedge:

Chainage	0	15	30	60	90	100	120
Offset (m)	7.1+R	8.0	10.1	12.0	7.5	7.9	6.4

Here R = 0.02 * Last Two digits of your Student ID. Calculate the area between the survey line, the hedge and the end offsets using trapezoidal rule.

(b) A railway embankment is 400m long and 12m wide at formation level. (22) It has a side slope of 2H: 1V. The reduced levels at every 50 m along the center line are as follows:

Distance (m)	RL (m)	Distance (m)	RL (m)
0	202.8	250	207.1
50	204	300	207.2
100	206.2	350	208
150	206.8	400	208.3
200	207.5		

The formation level at zero chainage is = (204 + Last Two Digits of Your Student ID * 0.1) m and the embankment has a rising gradient of 1 in 100. The ground level is across the centre line. Calculate the volume of earthwork.

4. (a) Differentiate between the following with figures (answer any two): **(12)**

(i) Celestial and Terrestrial equator

(ii) Zenith and Nadir

(iii) Altitude and Azimuth

(b) A steel tape of 20 m long and standardized at 55° F with a pull of 10 kg **(18)** was used for measuring a base line. Find the correction per tape length, if the temperature at the time of measurement was (80 + **Last two digits of Student ID**) ° F and the pull exerted was (16 + **Last two digits of Student ID* 0.2**) kg. Given, the weight of 1 cm^3 of steel = 7.86 g, weight of tape = 0.8 kg, E = 2.109 x 10^6 kg/cm^2 and α = 6.2 x 10^{-6} per °F.

SECTION – B

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

5. Bangladesh Space Research and Remote Sensing Organization **(30)** (SPARRSO) planned to deploy an aerial mapping technology in the northeastern area of Bangladesh for a national interest project. For conducting the survey, SPARRSO deployed an aircraft equipped with a high-resolution camera. SPARRSO decided that the scale factor of the survey would be used as 1 in: (1000 + X) ft. In the camera, the film holder is 8" x 8". The manufacturer of the camera stated that the focal length of the camera is 6 inches. For the project, it has been decided that the area to be mapped is square, 6 miles on each side. A side-lap from photo to photo of (0.3 + 0.002*(30 – X))*100 % is desired, as well as an end-lap from photo to photo of 60%. The plane travels at 150 mph. Assume X is the last two digits of your student number.

(i) What is the area covered by each photograph? (ii) At what altitude should the plane fly while taking photographs? (iii) How far apart will the flight paths be? (iv) How many flight paths are required? (v) How many photographs are required per flight path? (vi) How many photographs will be taken altogether? (vii) How frequently should the photographs be taken?

6. (a) In a curve setting problem, it has been identified that two tangents intersect at a chainage which can be defined by $(1100 + (30 = X)*40)$ m formula. It was also calculated that the deflection angle changes and can be measured using $(35 + (30 - X)*0.4)$ relationship. The survey team also measured that the Radius is 300m for the curve. From the given information, calculate the necessary data to set out the curve using Angular Method. Assume that the chain is 30m long. Note, X is the last two digits of your student number. **(22)**

(b) An 1800 kg car travels at 65 km/h around a banked curve with a radius of 150m. What should be the superelevation rate so that the tire friction is not needed to prevent the car from sliding? **(8)**

7. (a) Bangladesh Water Development Board (BWDB) deployed a hydrographic surveyor in a river on January 01, 2021. The surveyor reported several streamflow data from the hydrographic survey. From the data some data are presented in the following table. Compute the discharge and mean velocity from the data for the entire section. **(22)**

Distance from left bank	Total Depth, h (m)	Velocity (m/s)
0	0	-
2	0.80	0.61
5	3.40	0.96, 1.75
9	5.50	1.45, 1.78
13	7.60	1.50, 1.90
16	4.80	1.25, 1.70
18	2.60	0.89, 1.12
20	0	-

(b) In hydrographic survey, several methods are used for locating the locations of soundings. As per your present knowledge, which method best suits to conduct hydrographic survey for a large river in Bangladesh, and why? **(8)**

8. (a) Due to the higher difference between instrument station and staff **(18)** position, the observation becomes impossible when the telescope is kept horizontal. For replicating such scenario, a theodolite is used for a survey, where the tacheometric constant is 100 and an additive constant is zero. The center reading on a vertical staff held on a point B was 2.292 m when sighted from A. If the vertical angle was +25° and the horizontal distance AB 190.326 m, calculate the other staff readings. Are the two intercept intervals equal? Why or why not? Using these values calculate the level of B if A was 37.95 m and the height of the instrument 1.35 m.

(b) In Tachometric Survey, several sources of errors can be observed. For a **(12)** hypothetical survey terrain, it has been decided that the telescope should not be horizontal, and the staff is required to place in a non-vertical position. What could be the major sources of error for this condition? How can you eliminate those errors for the given scenario?

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations January 2020

Sub: **PHY 153** (Structure of Matter, Electricity & Magnetism and Modern Physics)

Full Marks: 180   Time: 2 Hours

The figures in the margin indicate full marks. Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

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

1. (a) Calculate the number of atoms per unit cell for (i) a simple cubic lattice; (ii) a   (22)
         body centered cubic lattice; and (iii) a face centered cubic lattice. How much
         portion of bcc structure is empty?

    (b) Potassium chloride (KCI) is a face-centered cubic crystal having a density of   (8)
         1.98 g/m^3. If its molecular weight is 74.6, calculate (i) the distance from one
         atom to the next atom of the same kind and (ii) the distance between adjacent
         atoms.

2. (a) Describe how can you define a crystal plane? Find the relation between Miller   (22)
         indices (hkl) and inter-planer distance (d_{hkl}) for a cubic crystal system.

    (b) Find the Miller indices of a set of parallel planes, which is parallel to the X-axis   (8)
         and make intercept in the ratio $4b{:}3c$ on the Y and Z-axes, a, b, c being the
         primitive vectors of the lattice.

3. (a) Describe how can you obtain diffracted beams from a crystal? Why normal   (22)
         light cannot be used in crystal structure analysis? Write down the characteristic
         features of Bragg's Law.

    (b) X-rays from a tube undergo first-order reflection at a glancing angle of 12   (8)
         degree from the face of a calcite crystal. The grating space of the calcite is
         3.04Å. Calculate the wavelength of the X-rays. At what angle will be third-
         order reflection take place from the crystal?

4. (a) What do you mean by mass-energy equivalence? Give a detailed analysis of   (22)
         where the equation $E = mc^2$ comes from. Show that the relativistic form of
         Newton's second law of motion is $F = m_o \frac{dv}{dt}(1 - \frac{v^2}{c^2})^{-\frac{3}{2}}$. The symbols have
         their usual meaning.

(b) An electron has a kinetic energy of 5 keV. Find its speed and mass in terms of **(8)**
its rest mass.

SECTION-B

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

5. (a) What do you understand by wave-particle duality? Discuss how the wave nature of **(22)**
a particle was proven.

(b) Green light has a wavelength of about 550 nm. Through what potential difference **(8)**
must an electron be accelerated to have this wavelength?

6. (a) Discuss four issues which justify that electron cannot exist in the nucleus. Find the **(22)**
radius of $^{12}_{6}C$ nucleus.

(b) The atomic ratio between the uranium isotopes ^{238}U and ^{234}U in a mineral sample **(8)**
is found to be 1.8×10^4. The half-life of ^{234}U is $2.5 \times 10^5 y$. Find the half life of
^{238}U.

7. (a) Express Coulomb's law of electrostatics in vector form when the origin of the **(15)**
coordinate system is considered (i) on any one of the two point charges, (ii) at
anywhere outside the point charges. What is the relation between the lines of force
and the electric field? (iii) Describe briefly why the concept of very small test
charge is important in defining electric field?

(b) Figure shows that three charges q_1, q_2 and q_3 are placed at different positions. **(15)**
Given that $q_1 = -1.0 \times 10^{-6}$ C, $q_2 = 3.0 \times 10^{-6}$ C, $q_3 = 2.0 \times 10^{-6}$ C, $r_{12} = 10$ cm, $r_{23} =$
15 cm, $\theta_1 = 45°$ and $\theta_2 = 30°$. Calculate the force acting on q_2.
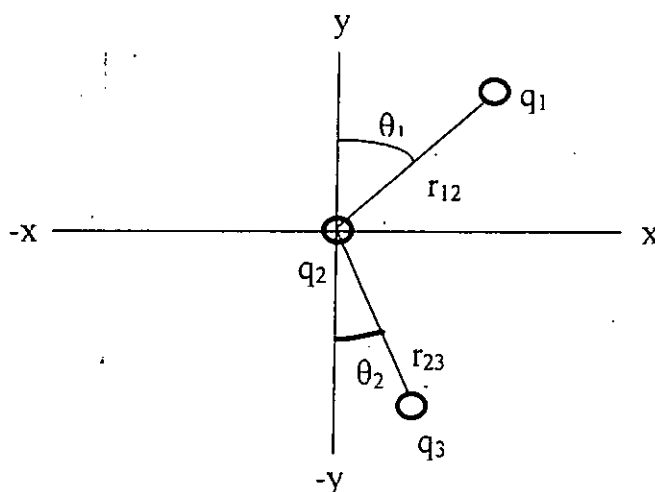
8. (a) What is meant by the terms self-inductance and mutual inductance? Obtain the **(15)** differential equation for a *RC*-circuit and solve it while the capacitor is (i) charging and (ii) discharging. Show *q(t)* qualitatively in a figure.

   (b) What is Hall effect? A copper strip 2.0 cm wide and 1.0 mm thick is placed in a **(15)** magnetic field, where B is perpendicular to the strip. If the current of 200 A is set up in the strip, the Hall potential difference appeared in equilibrium $V_{xy} = 22$ μV. Calculate the magnetic field of induction B (the electron density of copper is 8.4 $\times$ 10^{28}/m^3).

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-1/T-2   B. Sc. Engineering Examinations 2018-2019
Sub: **MATH 133** (Matrices and Three Dimensional Co-ordinate Geometry)
Full Marks: 180   Time: 2 Hours
USE SEPARATE SCRIPTS FOR EACH SECTION
The figures in the margin indicate full marks.
Symbols used have their usual meaning.

SECTION-A

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

1. (a) If $A = \begin{pmatrix} 3 & 7-4i & -2+5i \\ 7+4i & -2 & 3+i \\ -2-5i & 3-i & 4 \end{pmatrix}$ then show that A is Hermitian and iA is Skew- Hermitian.   (10)

    (b) Using only elementary row transformations, find the inverse of A when :   (20)
$$A = \begin{pmatrix} 1 & -1 & 2 \\ 2 & 0 & 3 \\ 0 & 1 & -1 \end{pmatrix}$$

2. (a) Reduce the matrix A to the normal form and obtain its rank, where   (12)
$$A = \begin{bmatrix} 1 & 4 & 5 & 2 \\ 2 & 1 & 3 & 0 \\ -1 & 3 & 2 & 2 \end{bmatrix}$$

    (b) For which values of λ, the following system have (i) a unique solution, (ii) infinitely many solutions and (iii) no solutions: (18)
$$x + y - z = 1$$
$$2x + 3y + \lambda z = 3$$
$$x + \lambda y + 3z = 2$$

3. (a) Test whether the vectors $v_1 = (-3,0,4)$, $v_2 = (5,-1,2)$ and $v_3 = (1,1,3)$ in R^3 are linearly independent or linearly dependent.   (15)

    (b) Using Cayley-Hamilton theorem find the matrix   (15)
$$A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$$
when $A = \begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$.

4. (a) If 2, 3 are the eigenvalues of the matrix $A = \begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ k & 0 & 2 \end{pmatrix}$ find the value of k. (10)

(b) Reduce the real quadratic form $4x^2 + 3y^2 - z^2 + 4xy + 2yz - 4xz$ to the canonical form and hence find the rank, signature and index of the form. (20)

SECTION-B

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

5. (a) A line makes angles $\alpha, \beta, \gamma, \delta$ with four diagonals of a cube. Find the value of $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma + \sin^2 \delta$. (20)

(b) Find the distance of (–1, 2, 5) from the line through (3, 4, 5) whose direction cosines are proportional to 2, –3, 6. (10)

6. (a) Find the distance between the plane x – 2y + 2z = 3 and the point (1, 2, –1). (15)

(b) Find the equation of the plane which is perpendicular to the plane 5x + 3y + 6z + 8 = 0 which contains the line of intersection of the planes (15)

x + 2y + 3z = 4 and 2x + y – z + 5 = 0.

7. (a) Find the equations of the line through the point (1, 2, 3) and perpendicular to the plane 3x + 4y – z = 7. (15)

(b) Find the shortest distance between the lines (15)
$\dfrac{x}{2} = \dfrac{y}{-3} = \dfrac{z}{1}$ and $\dfrac{x-2}{3} = \dfrac{y-1}{-5} = \dfrac{z+2}{2}$.

8. (a) Show that the tangent plane at (1, 2, 1) on the ellipsoid $2x^2 + y^2 + z^2 = 7$ touches the sphere $9x^2 + 9y^2 + 9z^2 + 18x - 54y - 90z + 311 = 0$. (15)

(b) Find the condition that the section of $ax^2 + by^2 + cz^2 = 1$ by lx + my + nz = p should be a circle. (15)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B.Sc. Engineering Examination, January 2020

Sub: HUM 113 (Economics)

Full Marks: 120   Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 03 page(s) in this question paper

SECTION – A

There are FOUR questions in this section. Answer any THREE

All the symbols have their usual meanings

Assume reasonable values for missing data.

1. (a) A manufacturer has a fixed cost of $120,000 and a variable cost of $60 per   (10)
    unit made and sold. Selling price is $90 per unit.
    - i)   Find the revenue, cost and profit functions using q for the
           number of units.
    - ii) Compute profit if 150000 units are made and sold.
    - iii) Find the break-even quantity.
    - iv) Construct the break-even chart. Label the cost and revenue
           lines, the fixed cost line, and the break-even point

    (b) Complete the following table and sketch the graph explaining the relations   (10)
    among the various short run cost corves.

Q	TFC	TVC	TC	AC	AVC	AFC	MC
1	90	30					
2	90	40					
3	90	45					
4	90	55					
5	90	75					
6	90	120					

2. (a) What is the relation among marginal revenue (MR), price (P) and price   (10)
    elasticity of demand (e)? What are the conditions of profit maximization?

    (b) Graphically explain the short run equilibrium of a firm under monopoly.   (10)

3.   (a) Explain producer's equilibrium with the help of iso-cost and isoquant   (10)

curves.

(b)) From the following functions calculate the amount of labour and capital   (10)
that maximize output. What is the maximum amount of output?

$$Q = 300L^{0.5}K^{.05}$$
$$4000 = 30L + 50K$$

4   (a) Explain any two methods for measuring national income.   (10)

(b) Given that, C = 100 + 0.75 Yd
                      I = 100,
                      G = 100,
                      X= 70,   (10)
                      M = 250,
                      TR = 200,
                      T = 0.15Y

    i)   Calculate the equilibrium level of income and multiplier in this model.
    .. ii)   If tax rate is increased to 20%, then what will be the new equilibrium
            level of income and multiplier?

SECTION – B

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

All the symbols have their usual meanings

5.   (a) What is meant by Production Possibility Frontier (PPF)? How does PPF of a   (15)
country indicate efficient resource allocation? Explain with example.

(b) Why do the students of Water Resources Engineering study Economics?   (5)

6. (a) Mathematically derive the equilibrium condition of the consumer for two (10)
    commodities under Cardinalist approach of utility analysis.

    (b) Why does demand curve slope downwards to the right? Briefly narrate the (10)
    four important factors that affect the demand for a commodity.

7. (a) Explain the concept of elasticity of demand. (5)

    (b) Briefly discuss the practical applications of elasticity of demand. (8)

    (c) Calculate the equilibrium price and quantity from the following demand
    and supply functions : (7)

    $$QD_x = 1200 - 5P_x$$
    $$QS_x = -500 + 12P_x$$

    What will happen to the equilibrium price and quantity when the
    government provides a subsidy of TK. 10 per unit? Graphically show the
    results.

8. (a) Define indifference curve and budget line. (5)

    (b) Derive a demand curve with the help of indifference curves and budget lines (15)

    and show that price effect is equal to substitution effect and income effect.

    Present and explain all necessary diagrams.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-II B.Sc. Engineering Examination 2018-19

Sub: **EEE 165** (Basic Electrical Technology)

Full Marks: 180   Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 6 page(s) in this question paper.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**
All the symbols have their usual meanings.
Assume reasonable values for missing data.

1.   (a) Find the equivalent resistance R_{eq} and current I in the circuit given in   (15)
Figure 1(a).
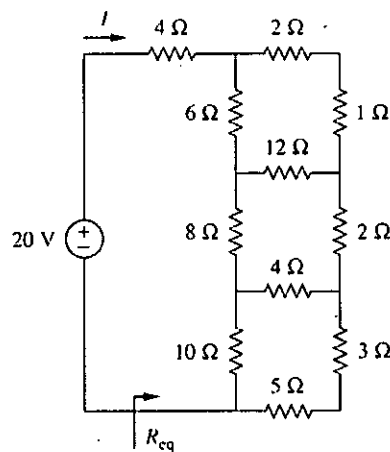
Figure 1(a)

(b) Calculate the mesh currents i_1 and i_2 for the circuit shown in Figure 1(b).   (15)
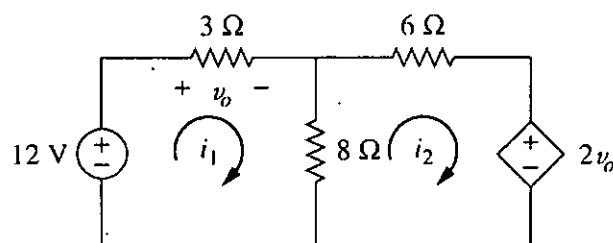
Figure 1(b)

2. (a) Calculate v_1 and v_2 in the circuit of Figure 2(a) using node analysis.   (10)
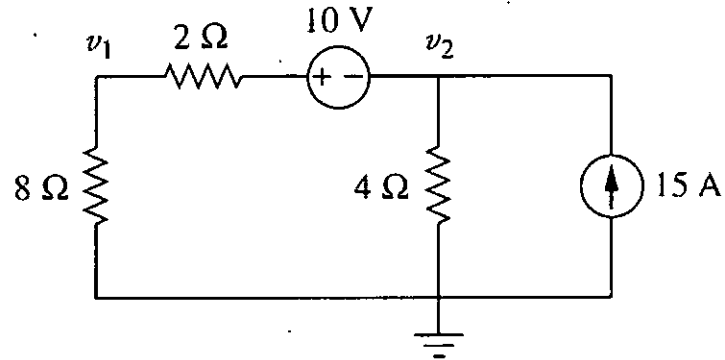
Figure 2(a)

(b) Use the superposition principle to find i_0 and v_0 in the circuit shown in   (20)
Figure 2(b).
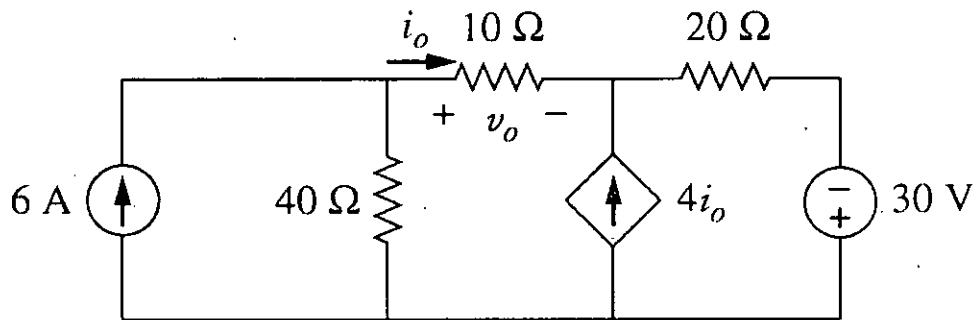
Figure 2(b)

3. (a) Apply Thevenin's theorem to find V_0 in the circuit shown in Figure 3(a).   (20)
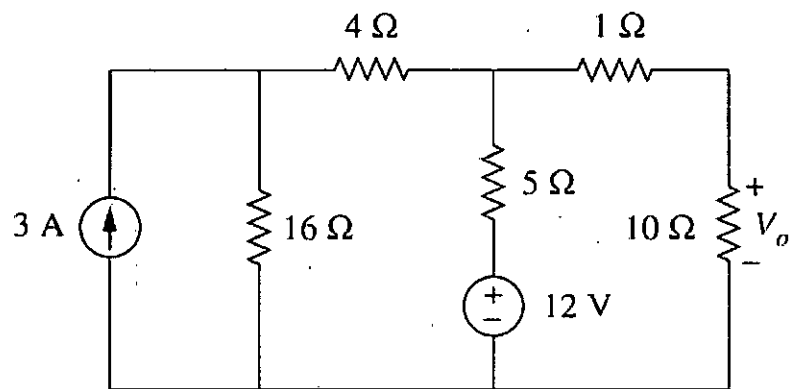
Figure 3(a)

(b) Compute the value of R that results in maximum power transfer to the 10 Ω   (10)
resistor in the circuit shown in Figure 3(b). Find the maximum power.
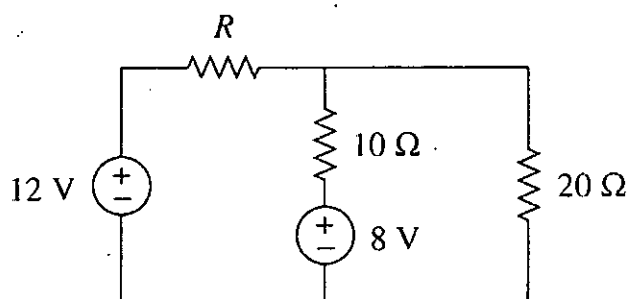
Figure 3(b)

4   (a) Define voltage regulation and efficiency of a transformer. Briefly describe   (12)
the different types of losses occur in a transformer.

(b) Data from short circuit and open circuit tests of a 60 Hz, 20 KVA,   (18)
20000-480 V transformers are,

$V_{OC} = 480\ V$	$V_{SC} = 1130\ V$
$I_{OC} = 1.6\ A$	$I_{SC} = 1\ A$
$P_{OC} = 3.5\ W$	$P_{SC} = 260\ W$

The transformer is operating at rated voltage, rated KVA and 0.8 power-factor
leading in the step-up mode. Determine (i) efficiency and (ii) voltage regulation
of the transformer.

SECTION – B

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

All the symbols have their usual meanings

5.   (a) Draw the complete phasor diagram showing the voltage across each element   (20)
and the current through each element for the circuit shown in Figure 5 where I_1
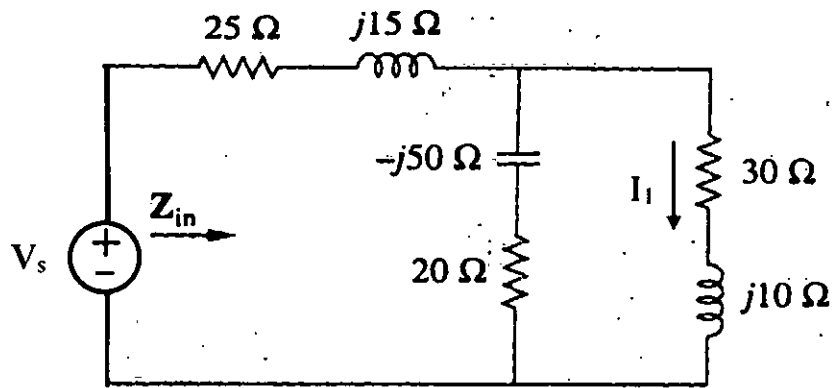= $2\angle 0°$ A (rms). What is the source voltage, V_s?

Figure 5

(b) Determine the equivalent impedance Z_{in} for the circuit shown in Figure 5.   (10)

6.   (a) Two loads (Z_1 and Z_2) are connected to a 220V(rms) 50Hz power source as   (15)
shown in Figure 6(a). Determine the total load current (I_L) drawn from the source.
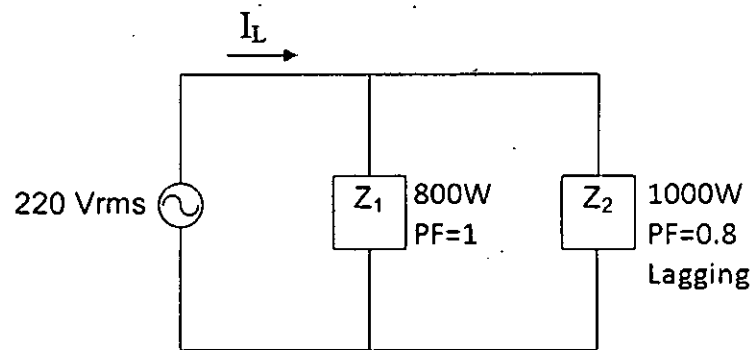What is the over all power factor?

Figure 6(a)

(15)

(b)   An industrial load is modeled as a series combination of an inductance L and resistance R, as shown in Figure 6(b). With an ac voltmeter, the following measurements are taken at 60 Hz: V_s = 145V, V_1 = 50V, V_o = 110V

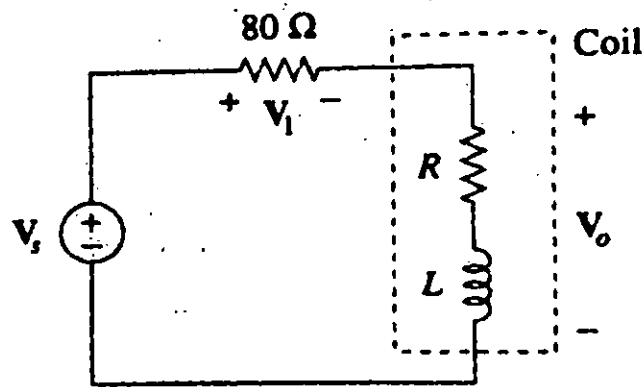Use these measurements to determine the values of L and R.

Figure 6(b)

7.   (a) A Y-connected balanced three phase generator with an impedance of 0.4 +   (15)
j0.3 Ω per phase is connected to a Y-connected balanced load with an impedance of 24 + j19 Ω per phase. The line joining the generator and the load has an impedance of 0.6 + j0.7 Ω per phase. Assuming a positive sequence for the source voltages and that V_{an} = 220∠0° V, find: (a) the line voltages, (b) the line currents.

(b) The two wattmeter readings of the balanced three phase system shown in   (15)
Figure 7 are P_1 = -560W and P_2 = 800W. The line voltage is 208V. Determine:
i) the total average power
ii) the total reactive power
iii) the power factor
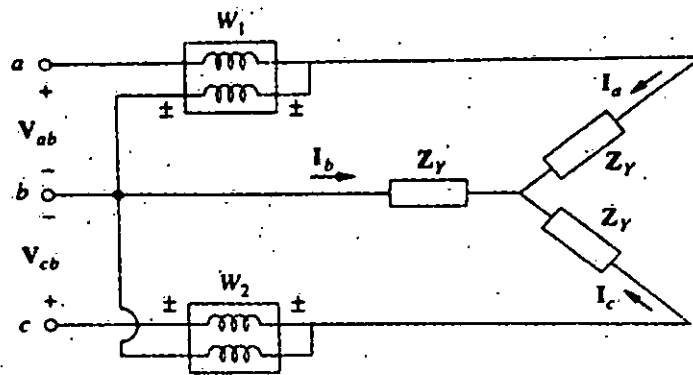iv) the phase impedance

Figure 7

8.   (a) Draw the power flow diagram and explain different types of losses that occur   (10)
in an induction motor.

(20)

(b) A 208 V, two-pole, 60 Hz, Y-connected wound rotor induction motor is
rated at 15 hp. Its equivalent circuit components are:

$R_1 = 0.2\ \Omega$, $R_2 = 0.12\ \Omega$, $X_m = 15\ \Omega, X_1 = 0.41\ \Omega$

$X_2 = 0.41\ \Omega$, $P_{mech} = 250\ W$, $P_{misc} = 0$, $P_{core} = 180\ W$

For a slip of 0.05, find

(i) The line current I_L

(ii) The stator copper losses P_{SCL}

(iii) The air gap power P_{AG}

(iv) Power converted from electrical to mechanical P_{conv}

(v) The induced torque τ_{ind}

(vi) The load torque τ_{load}