Faiah Hayee

L-1/T-2/WRE **Date : 06/10/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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

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) Determine I_{aA} and V_{BN} for the following circuit: **(18)**

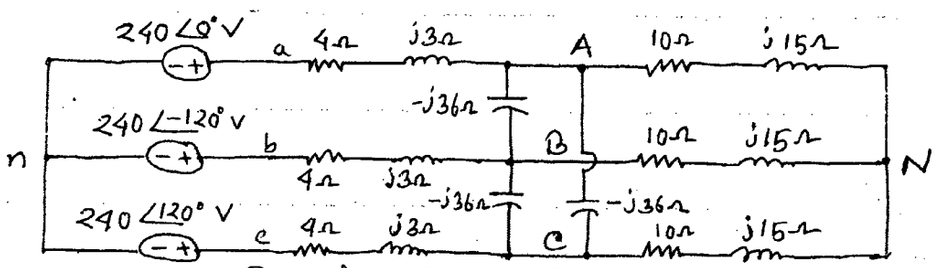

Fig. for Q. 1(a)

(b) For a balanced Y-Δ system consisting of a balanced Y-connected source feeding a balanced Δ-connected load, determine the equations for phase and line voltages and the phase and line currents. Also, show these in a phasor diagram. **(12)**

(c) Prove that, the three-phase transmission system uses a lesser amount of wire than the single-phase system for the same line voltage V_L and the same absorbed power P_L. **(5)**

2. (a) Given the following magnetic flux in a single phase transformer core, draw the waveshape of the secondary side voltage and also determine the rms value of it. **(10)**

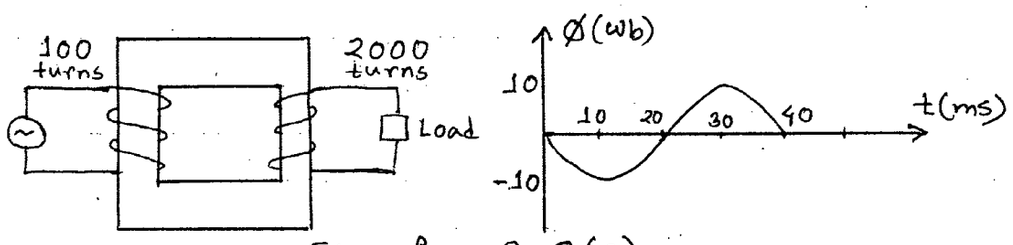

Fig. for Q. 2(a)

(b) Draw the exact equivalent circuit of a transformer. How approximate equivalent circuit can be obtained from it? Draw the approximate equivalent circuit. **(10)**

Contd P/2

20

EEE 165 (WRE)

Contd... Q. No. 2

(c) A single-phase, 25 kVA, 2200 - 600 V, 60 Hz transformer used for step-down operation has the following parameters expressed in ohms: **(15)**

$$R_{HS} = 1.40 \quad X_{HS} = 3.20 \quad X_{M,HS} = 5011$$
$$R_{LS} = 0.11 \quad X_{LS} = 0.25 \quad R_{fe,HS} = 18694$$

sketch the appropriate equivalent circuit and determine: (i) the input voltage required to obtain an output of 25 kVA at 600 V and 0.8 pf lagging, (ii) the load component of primary current, (iii) the exciting current.

3. (a) Data from short-circuit and open-circuit tests of a 60 Hz, 100 kVA, 4600 - 230 V transformer are: **(12.5)**

$$V_{OC} = 230\,V \qquad V_{SC} = 172.3\,V$$
$$I_{OC} = 14\,A \qquad I_{SC} = 20.2\,A$$
$$P_{OC} = 60\,W \qquad P_{SC} = 1046\,W$$

Determine: (i) the magnetizing reactance referred to the high-side, (ii) the equivalent core loss resistance referred to the high-side, (iii) the equivalent resistance, reactance and impedance referred to the high-side.

(b) The equivalent low-side parameters of a 250 kVA, 4160 - 480 V, 60 Hz transformer are $R_{eq,LS}$ = 0.0092 Ω and $X_{eq,LS}$ = 0.0433 Ω. The transformer is operating in the step down mode and is delivering rated current at rated voltage to a 0.84 pf lagging load. Determine (i) the no-load voltage, (ii) the actual input voltage at the high side, (iii) the high-side current, (iv) the input impedance. **(10)**

(c) A 50-kW, 440 V, 50 Hz six-pole induction motor has a slip of 6 percent when operating at full-load conditions. At full-load conditions, the friction and windage losses are 300 W and the core losses are 600 W. Find the following values for full-load conditions: **(12.5)**

(i) The shaft speed n_m
(ii) The output power in watts
(iii) The load torque
(iv) The induced torque
(v) The rotor frequency

4. (a) With detailed diagrams, explain how a three-phase supply in an induction motor can create a rotating magnetic field in the stator. **(15)**

Contd P/3

EEE 165 (WRE)

Contd... Q. No. 4

(b) A 208 V, two-pole, 60 Hz, Y-connected wound-rotor induction motor is rated at 15 hp. Its equivalent circuit components are: **(16)**

$R_1 = 0.2\ \Omega$ $R_2 = 0.12\ \Omega$ $X_M = 15\ \Omega$

$X_1 = 0.41\ \Omega$ $X_2 = 0.41\ \Omega$

$P_{mech} = 250$ 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}

(vii) The overall machine efficiency

(viii) The motor speed in rpm and radians per second

(c) Compare the magnetization curves of an induction motor and a transformer. **(4)**

SECTION – B

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

5. (a) The current entering the positive terminal of a device is $i(t) = 3e^{-2t}$ A and the voltage across the device is $v(t) = 5\frac{di}{dt}$ V. **(17)**

(i) Find the charge delivered to the device between t = 0 and t = 2s.

(ii) Calculate the power absorbed at t = 1s.

(iii) Determine the energy absorbed in 3s.

(b) Find R_{ab} in the circuit shown in figure 5(b). **(18)**

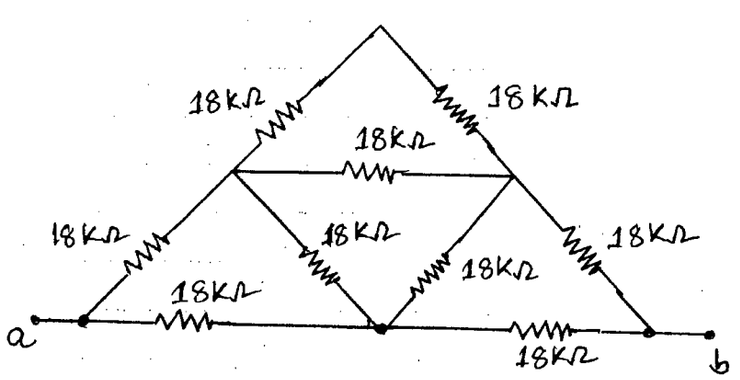

Figure for question no. 5(b)

Contd P/4

EEE 165 (WRE)

6. (a) Use nodal analysis method to find v_0 in the circuit shown in figure 6(a). **(17)**

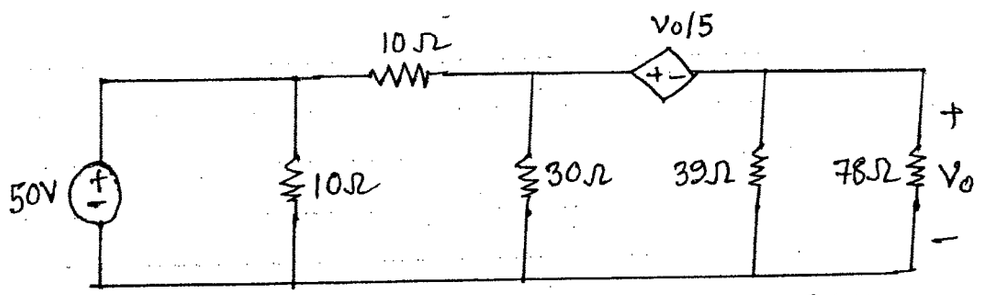

Figure for question no. 6 (a)

(b) Find v_x and i_x in the circuit shown in figure 6(b), using mesh analysis. **(18)**

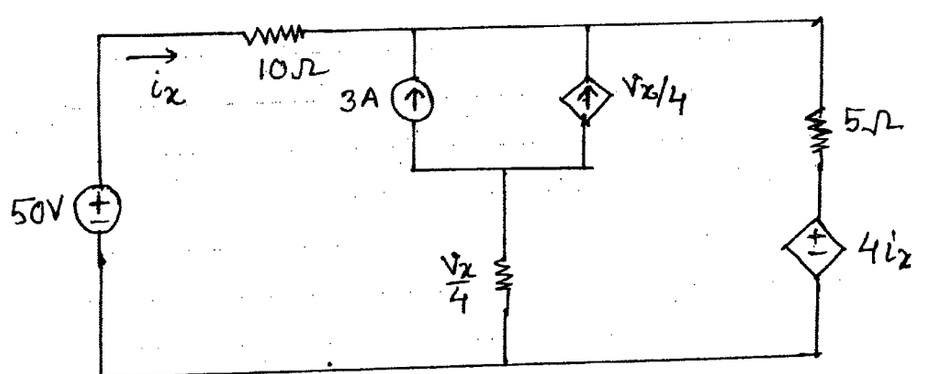

Figure for question no. 6(b)

7. (a) Find v(t) and i(t) for the circuit shown in figure 7(a). **(13)**

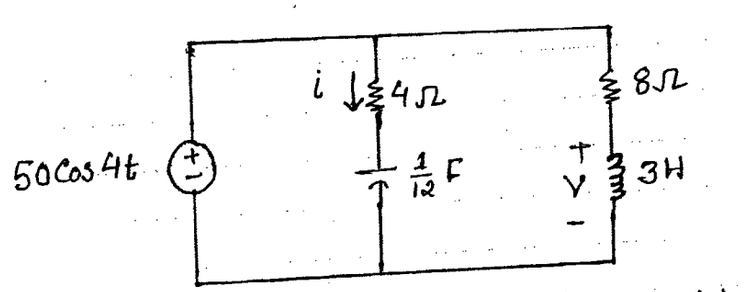

Figure for question. no. 7 (a)

(b) Given, $v(t) = V_m \cos(\omega t + \theta_v)$ and $i(t) = I_m \cos(\omega t + \theta_i)$, show that average power, P is given by $P = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i)$. **(12)**

Contd P/5

EEE 165 (WRE)

Contd... Q. No. 7

(c) Obtain the rms value of the current waveform shown in figure 7(c). If this current is passed through a 2-Ω resistor, find the average power absorbed by the resistor. **(10)**

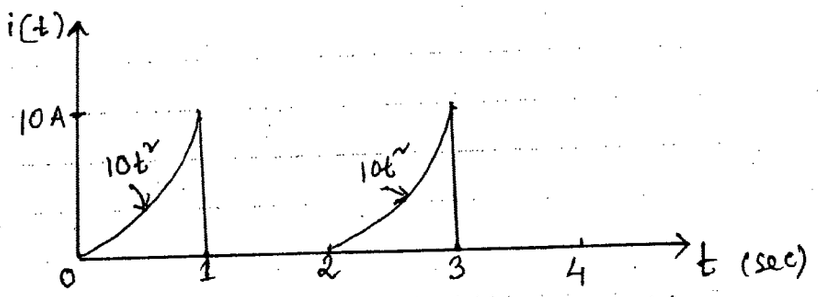

Figure for question no. 7(c)

8. (a) For the circuit shown in figure 8(a), calculate– **(18)**

   (i) The power factor with respect to the source.

   (ii) The average power, reactive power, apparent power and complex power of the source.

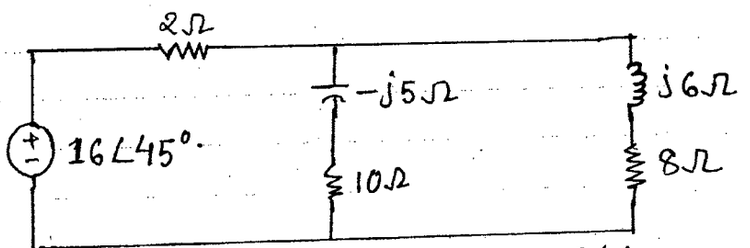

Figure for question. no 8(a)

(b) An 880 VA, 220 V, 50 Hz load has a power factor of 0.8 lagging. What value of parallel capacitance will correct the load power factor to unity? **(17)**

L-1/T-2/WRE **Date : 29/09/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **HUM 113** (Economics)

Full Marks : 140 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 graphically the concepts of total utility and marginal utility. **(7)**

   (b) Describe the assumptions of the cardinal theory of consumer equilibrium. **(3 ⅓)**

   (c) Narrate the cardinal theory of consumer equilibrium. **(13)**

2. (a) Define demand schedule and demand curve. Draw a demand curve from its demand schedule and explain the inverse relationship between price and demand. **(5)**

   (b) What is meant by market demand? Explain graphically. **(5)**

   (c) Explain the factors that affect the supply of a commodity. **(5 ⅓)**

   (d) Calculate the equilibrium price and quantity from the following demand and supply functions and graphically show the results. **(8)**

   $QD_x = 1200 - 5P_x$

   $QS_x = -500 + 12P_x$

3. (a) Explain how the prices of other commodities affect the demand for a commodity. **(8)**

   (b) Discuss in detail price elasticity of demand, income elasticity of demand and cross elasticity of demand. **(9 ⅓)**

   (c) From the following table calculate the price elasticity of demand when you move from point A to point C and from point C to point A. **(6)**

Point	Price	Quantity
A	10	300
B	9	350
C	8	400

4. (a) Define an indifference curve. Make a hypothetical indifference Schedule, plot the Schedule on a graph and explain. **(5 ⅓)**

   (b) Briefly discuss the properties of indifference curve. **(8)**

   (c) Define Substitution effect and income effect of a price change. Show that price effect is equal to substitution effect and income effect. Present and explain all necessary diagrams. **(10)**

Contd P/2

HUM 113

SECTION – B

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

5. (a) What are the assumptions of a perfectly competitive market? Explain them. **(10)**

   (b) Explain the long-run equilibrium of a firm under perfect competition. **(10)**

   (c) Graphically explain the shut-down point of a firm under perfect competition. **(3 ⅓)**

6. (a) Explain the short-run equilibrium of a firm under monopoly. **(10)**

   (b) What is the relation among marginal revenue, price and price elasticity of demand in case of monopoly? **(8 ⅓)**

   (c) When does a firm emerge as a monopolist? **(5)**

7. (a) Explain producer's equilibrium with the help of iso-cost and isoquant curves. **(13 ⅓)**

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

   $Q = 500\ L^{0.6}\ K^{0.7}$

   $3000 = 50L + 70\ K$

   Here Q = output

   L = Labour

   K = Capital.

8. (a) How would you derive the long-run average cost curve of a firm from its short-run average cost curves? **(10)**

   (b) Define and explain fixed cost and variable cost. **(8 ⅓)**

   (c) From the following function, find the AC, MC, AVC, AFC functions and amount of output when MC and AVC will be minimum. **(5)**

   $$C = 180 - 6Q - \frac{5}{2}Q^2 + \frac{1}{3}Q^3$$

16.9.13

L-1/T-2/WRE Date : 24/07/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **PHY 153** (Structure of Matter, Electricity, 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) State and explain Coulomb's law and Gauss' law of electrostatics. **(8)**

   (b) Using Gauss' law obtain expressions for electric field E at a point P at a distance r from the centre of a uniformly distributed conducting sphere of radius R for **(15)**

   (i) Outside (r > R)

   (ii) Inside (r < R) and

   (iii) Surface (r = R) of the sphere

   Draw schematically E(r) as a function of r.

   (c) Define electrostatic potential energy and electric potential. **(6)**

   (d) Sketch qualitatively the lines of force associated with +3Q and –Q charges by considering as limiting cases points very close to the –Q charge and very far from it. **(6)**

2. (a) What is a dielectric material? Show that when space between the plates of a parallel plate capacitor is filled with material of dielectric constant ϕ_c K Gauss's law of electrostatics becomes $\epsilon_0 \oint k\vec{E} \cdot d\vec{S} = q$. **(16)**

   (b) Write down the four Maxwell's equations of electromagnetism. Explain the physical significance of any two of them. **(10)**

   (c) A solenoid is 1.0 m long and 3.0 m in mean diameter. It has 5 layers of windings of 850 turns each and carries current of 5.0 amp. What is the value of magnetic field at the centre of the solenoid? **(9)**

3. (a) The charged particle originated from the solar wind deflected by earth's magnetic field and produce Aurora. Explain briefly about the "Aurora". **(10)**

   (b) Write short notes on paramagnetic materials. **(6)**

   (c) Briefly explain why Kirchhoff's theorem becomes invalid in case of electromagnetic induction. **(5)**

   (d) The following figure shows a circuit containing a self inductor of inductance L and a resistor of resistance R in series with a battery through a switch k. **(14)**

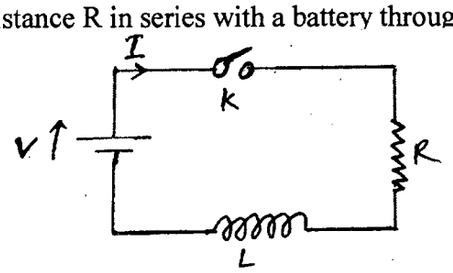

Fig. ~~7(d)~~ for Q. 3(d)

   (i) Obtain an expression for the growth of current in the circuit.

   (ii) Draw schematically current vs time in that case.

Contd P/2

PHY 153 (WRE)

4. (a) Write down the postulates of special theory of relativity. Define inertial and non-inertial frames? **(9)**

   (b) Derive the equation for the fringe shift in Michelson-Morley experiment and explain each term. **(18)**

   (c) A car is moving with a constant velocity 72 km/h. Show that driver in the car and an observer on the road both find the same value for the speed of light. **(8)**

SECTION – B

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

5. (a) Show that for blackbody radiation Rayleigh-Jeans law agrees with Planck radiation formulae at low frequency region. **(7)**

   (b) How would you determine the value of Planck constant? **(10)**

   (c) Write down the failures of classical wave theory about photoelectric effect. **(8)**

   (d) An electron has a kinetic energy of 2.5 eV. Calculate the de Broglie wavelength of the electron. **(10)**

6. (a) Show that mean life of a radioactive substance, $\tau = 1/\lambda$, where λ is radioactive decay constant. **(13)**

   (b) Show that an electron can reside on the orbital but it can't reside inside the nucleus. **(14)**

   (c) Calculate the binding energy of deuteron. Given that mass of proton = 1.00728 a.m.u.; mass of neutron = 1.00866 a.m.u; mass of deuteron = 2.01361 a.m.u. **(8)**

7. (a) Distinguish between (i) crystal and non-crystalline solids (ii) single crystal and poly crystal (iii) primitive and conventional unit cells. **(18)**

   (b) What is coordination number? What are the value of coordination number for sc, bcc, fcc and diamond lattice. **(7)**

   (c) Calculate the packing fraction for BCC and FCC lattices. **(10)**

8. (a) Define Miller indices. Describe how are these determined. What is crystal direction? Draw [100] and [001] crystal direction for FCC lattice. **(13)**

   (b) Find an expression for the interplanar distance for cubic lattice employing Miller indices. Draw (100), (111), (001) crystal planes for FCC crystal. **(17)**

   (c) A cubic lattice has a lattice constant of 0.3 nm. Calculate interplanar distance for a plane (110). **(5)**

L-1/T-2/WRE **Date : 08/07/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **WRE 103** (Surveying)

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**.

The symbols have their usual meaning.

1. (a) Write short note on Gunter's chain. **(8)**

(b) Draw the conventional symbols for the following objects in chain surveying **(6)**

(i) Embankment
(ii) Fence
(iii) Tunnel
(vi) Dam
(v) Bench mark
(vi) Deciduous and evergreen trees

(c) A 20 m long steel tape was used to measure a base line whose length was found to be 1023 m. The tape was standardized at a temperature of 55°F and a pull of 10 kg. Find the correction per tape length if the temperature at the time of measurement was 80°F and the pull exerted was 16 kg. Following information is given: **(20⅔)**

Weight of 1 cubic meter of steel = 7.86 gm

Weight of tape = 0.8 kg

$E = 2.109 \times 10^6$ kg/cm^2, $\alpha = 6.2 \times 10^{-6}$/°F.

(d) A 30 m chain was used to survey a land at Gazipur. The length of the chain at the beginning of the survey was found to be 30.10 m and 30.30 m at the end of survey. The area of the plan drawn to a scale of 1 cm = 9 m was measured with a planimeter and was found to be 32.56 cm^2. Find the true area of the field. **(12)**

2. (a) What is closing error? Explain. **(4)**

(b) How can you calculate the reduced bearing (RB) if the whole circle bearings (WCB) are known? **(6)**

(c) Calculate the area of the closed traverse ABCDEFA **(20)**

Side	WCB	Length (ft)
AB	342°48′	287
BC	36°15′30″	260
CD	83°21′	220
DE	148°53′40″	280
EF	204°28′30″	320
FA	~~247~~°28′30″	300

274

Contd P/2

WRE 103

Contd... Q. No. 2

(d) For the closed traverse ABCDEFA find out the missing values from the following data: **(16⅔)**

Side	Length (m)	Bearing
AB	400	135°30′
BC	430	85°35′
CD	450	46°15′
DE	500	?
EF	350	~~247°30′~~ 274°30′
FA	450	?

3. (a) Define the following terms: **(5×2=10)**
   (i) Bench mark
   (ii) Height of instrument
   (iii) Change point
   (iv) Datum
   (v) Back and fore readings

   (b) What is contour? State the characteristics of contour. **(2+6=8)**

   (c) The top of a lighthouse is just visible above the horizon from the deck of a ship. The top of the light house is 87 m above the mean sea level (MSL) and the height of the eye of the observer is 6 m above the MSL. Find the distance of the observer from the lighthouse. **(8⅔)**

   (d) The following readings were taken while leveling along the central line of a proposed road. It was decided to keep the formation level of the road 2 ft above the ground level 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 BM of RL 606.90 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. **(20)**

Chainage (ft)	Staff Reading (ft)	Chainage (ft)	Staff Reading (ft)
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

4. (a) Derive an expression for the horizontal and vertical distances from a tacheometer when the line of sight is inclined and the staff held is perpendicular to the line of sight. **(16)**

   (b) Discuss the procedure by which tacheometric constant can be determined. **(6)**

   (c) Write short note on GPS and GIS. **(4)**

Contd P/3

WRE 103

Contd... Q. No. 4

(d) A tacheometer was placed at a station A and readings on the staff held vertically at B were 2.255, 2.605 and 2.955. The line of sight being at an inclination of +8°24′. Another observation on the staff held vertically at BM gave readings 1.640, 1.920 and 2.200, the inclination of the line of sight being +1°6′. Calculate the horizontal distance between A and B and the elevation of B if the R.L. of BM is 118.685 m. Take the value of multiplying constant 100 and the additive constant 0.30. **(20⅔)**

SECTION – B

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

5. (a) Give a definition sketch of a simple circular curve and define all related notations and parameters. **(12⅔)**

(b) Two straight alignments of a proposed road intersect at chainage (58+34), the angle of intersection being 139°30′. It is proposed to insert a circular curve with transition curve in between alignments. The speed of the vehicles is 60.5 km/hr and allowable Centrifugal ratio is 0.144. A transition curve have to be inserted where width of the road pavement is 7 m and the rate of superelevation of this road is 1 in 50. Calculate the necessary data to set out the combined curve by deflection angles. Assume that the chain is 20 m long. **(22)**

(c) State the advantage of a vertical curve over circular curve. Write the procedure to locate a vertical curve. **(12)**

6. (a) What is hydrographic surveying? Write the use of hydrographic surveying. **(8)**

(b) What is sounding? Why sounding is required? Which method is mostly used for locating sounding point by BWDB. **(10⅔)**

(c) The following data are obtained in a stream-gauging operation. A current meter with calibration equation v=(0.32N+0.32)m/s, where N = revolution per second was used to measure the velocity at 0.6 depth. Calculate the discharge and mean velocity for the entire section from the data given below. **(18)**

Distance from the left water edge (m)	0	1.0	3.0	5.0	8.0	9.0	11.0	12.0
Total Depth (m)	0	1.1	2.0	2.5	2	1.7	1.0	0
Revolution of current meter	0	39	58	112	90	45	30	0
Duration of observation (sec)	0	100	100	150	150	100	100	0

(d) An irrigation canal 2 km long with 20 m bottom width is to be constructed. The canal has a side slope of 1:1 and original ground has a uniform slope of 1 in 5 the transverse direction. The average depth of cutting along the centre line is 8 m. Calculate the volume of earthwork in cutting. (See Figure 1) **(10)**

Contd P/4

WRE 103

7. (a) What is Refractive Index. Determine the refractive index of a field 36000 km^2 which is represented by 8 cm by 5 cm on map. **(6)**

(b) Write short notes on (i) Reconnaissance Survey (ii) The Dependent Equatorial System (iii) Mean Solar Time. **(9)**

(c) Draw a figure showing solstices positions of sun on celestial sphere. **(10)**

(d) A point P lies to the west of Q and the meridian distance between them is 1 hr 30 min. The longitude of Q is 62°30′40″(W). Calculate the longitude of P. **(7)**

(e) To determine the index error of a theodolite, a church spire was sighted and the face left and face right observations were 18°36′48″ and 18°35′56″ respectively. A face right observation on the sun's lower limb was then made and the altitude was found to be 28°36′20″. The semi-diameter of the sun at the time of observation was 15′59.35″. Find the true altitude of sun. **(14⅔)**

8. (a) Define the following terms: (i) Eccentric Camera Station (ii) Crab (iii) Tilted Photograph (iv) Fiducial Marks. **(8)**

(b) Describe the five operations in aerial photogrammetry. **(10⅔)**

(c) A camera having a focal length of 20 cm is used to take a vertical photograph of a terrain having an average elevation of 1500 m above the mean sea level. What is the height above the mean sea level at which an aircraft must fly to get the photograph at a scale of 1:8000? **(6)**

(d) An area 30 km long in the north-south direction and 24 km in the east-west direction is to be photographed with a lens having 30 cm focal length for the purpose of compiling a topographic map. The size of the photograph is 20 cm × 20 cm. The average scale is to be 1:12000 effective at an average elevation of 400 m above datum. Overlap is to be at least 60% and sidelap is to be at least 30%. The ground speed of the aircraft will be maintained at 200 km/hr. The flight lines are laid in a east-west direction on an existing map having a scale of 1:60000. The two outer flight lines are to be coincided with north-south boundaries of the area. Determine (i) Flight Height (ii) Spacing of flight lines on the flight map. **(22)**

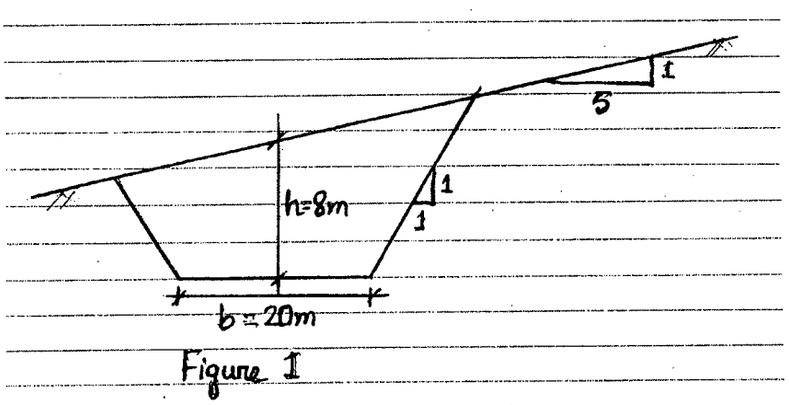

Figure 1

L-1/T-2/WRE Date : 23/09/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **MATH 133** (Matrices and Three Dimensional Co-ordinate Geometry)

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) Find the inverse of the matrix $A = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{pmatrix}$ by (i) adjoint method and (ii) elementary row operation of matrices. Then show that $AA^{-1} = I_3$. **(18)**

(b) Reduce the matrix $A = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 7 & 3 & 5 \\ 3 & 8 & 1 & -2 \\ 2 & 4 & 6 & 8 \end{pmatrix}$ to echelon form, then to its canonical form and write down the rank and nullity. **(17)**

2. (a) Solve the following system of equations by reducing the augmented matrix to its canonical form: **(18)**

$$x + y + z + w = 4$$
$$2x - y - z + 3w = 6$$
$$3x + 4y - 5z + 6w = -11$$
$$7x - 5y + 7z + w = 46$$

(b) Solve the following homogeneous system of equations by reducing the coefficient matrix to its canonical form: **(17)**

$$2x_2 + 2x_3 + 4x_4 = 0$$
$$x_1 - x_3 - 3x_4 = 0$$
$$-2x_2 - 2x_3 - x_4 = 0$$
$$2x_1 + 3x_2 + x_3 + x_4 = 0$$
$$-2x_1 + x_2 + 3x_3 - 2x_4 = 0$$

3. (a) Find the eigen values, eigen vectors and eigen spaces of the matrix, **(20)**

$$A = \begin{bmatrix} 5 & 4 & -1 \\ 4 & 5 & -1 \\ -4 & -4 & 2 \end{bmatrix}.$$

(b) State Cayley-Hamilton theorem and verify it for the matrix $A = \begin{pmatrix} 1 & -1 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{pmatrix}$ and hence find the inverse of A. **(15)**

Contd P/2

MATH 133

4. (a) The vectors $v_1 = (1,-1, 5, 2)$, $v_2 = (-2, 3, 1, 0)$, $v_3 = (8, -11, 7, 4)$, $v_4 = (5, 7, 2, -3)$ and $v_5 = (16, 7, 23, 2)$ are linearly dependent. Find a linearly independent set of vectors from those. Then find their dependency equations. **(15)**

(b) Reduce the quadratic form $q = X'AX = x^2 + 5z^2 + 4xy + 6xz + 8yz$ to its equivalent diagonal form. Find the transformation matrix P that diagonalizes A, and write down the equivalent diagonal matrix D. Then write down the rank, index and signature. **(20)**

SECTION – B

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

5. (a) The direction-cosines of two straight lines are given by the relations $al + bm + cn = 0$ and $fmn + gnl + hlm = 0$. Find the condition so that the straight lines are perpendicular. **(18)**

(b) Test whether the four points (0, –1, 0), (2, 1, –1), (1, 1, 1) and (3, 3, 0) are coplanar or not. If they are coplanar find the equation of the plane. **(17)**

6. (a) A variable plane is at a constant distance p from the origin O and meets the axes in A, B and C. Find the locus of the centroid of the tetrahedron OABC. **(17)**

(b) Find the equation of the plane through the points (2, –1, 0), (3, –4, 5) and parallel to the line $2x = 3y = 4z$. **(18)**

7. (a) Test whether the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ are coplanar or not. If they are, then find the equation of the plane and their point of intersection. **(17)**

(b) Find the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$. Also find the equations of the shortest distance and the points of intersections. **(18)**

8. (a) Find the equation of the sphere which passes through the circle $x^2 + y^2 + z^2 - 2x + 2y + 4z - 3 = 0$, $2x + y + z - 4 = 0$ and touches the plane $3x + 4y - 14 = 0$. **(17)**

(b) Show that the plane $3x + 12y - 6z = 17$ touches the conicoid $3x^2 + 6y^2 + 9z^2 + 17 = 0$ and hence find the point of contact. **(18)**

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L-1/T-2/WRE **Date : 06/10/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2011-2012

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

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) Determine I_{aA} and V_{BN} for the following circuit: **(18)**

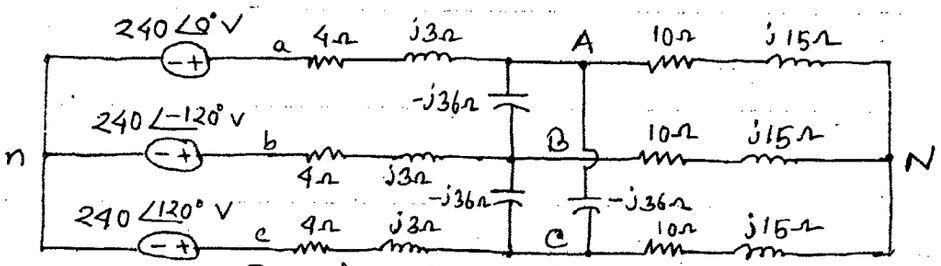

Fig. for Q. 1(a)

(b) For a balanced Y-Δ system consisting of a balanced Y-connected source feeding a balanced Δ-connected load, determine the equations for phase and line voltages and the phase and line currents. Also, show these in a phasor diagram. **(12)**

(c) Prove that, the three-phase transmission system uses a lesser amount of wire than the single-phase system for the same line voltage V_L and the same absorbed power P_L. **(5)**

2. (a) Given the following magnetic flux in a single phase transformer core, draw the waveshape of the secondary side voltage and also determine the rms value of it. **(10)**

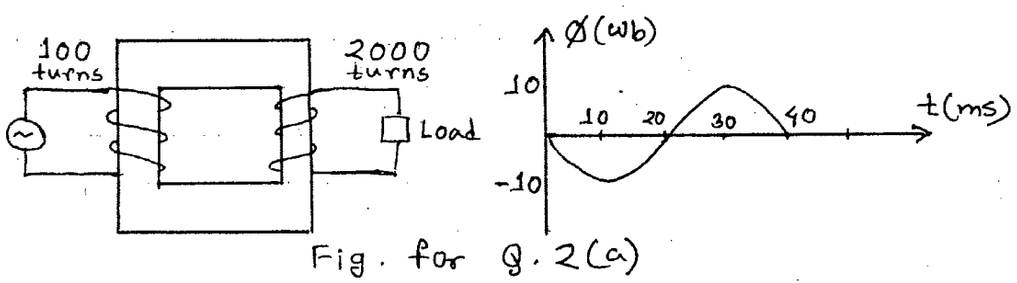

Fig. for Q. 2(a)

(b) Draw the exact equivalent circuit of a transformer. How approximate equivalent circuit can be obtained from it? Draw the approximate equivalent circuit. **(10)**

Contd P/2

EEE 165 (WRE)

Contd... Q. No. 2

(c) A single-phase, 25 kVA, 2200 - 600 V, 60 Hz transformer used for step-down operation has the following parameters expressed in ohms: **(15)**

$$R_{HS} = 1.40 \quad X_{HS} = 3.20 \quad X_{M,HS} = 5011$$
$$R_{LS} = 0.11 \quad X_{LS} = 0.25 \quad R_{fe,HS} = 18694$$

sketch the appropriate equivalent circuit and determine: (i) the input voltage required to obtain an output of 25 kVA at 600 V and 0.8 pf lagging, (ii) the load component of primary current, (iii) the exciting current.

3. (a) Data from short-circuit and open-circuit tests of a 60 Hz, 100 kVA, 4600 - 230 V transformer are: **(12.5)**

$$V_{OC} = 230\,V \qquad V_{SC} = 172.3\,V$$
$$I_{OC} = 14\,A \qquad I_{SC} = 20.2\,A$$
$$P_{OC} = 60\,W \qquad P_{SC} = 1046\,W$$

Determine: (i) the magnetizing reactance referred to the high-side, (ii) the equivalent core loss resistance referred to the high-side, (iii) the equivalent resistance, reactance and impedance referred to the high-side.

(b) The equivalent low-side parameters of a 250 kVA, 4160 - 480 V, 60 Hz transformer are $R_{eq,LS}$ = 0.0092 Ω and $X_{eq,\,LS}$ = 0.0433 Ω. The transformer is operating in the step down mode and is delivering rated current at rated voltage to a 0.84 pf lagging load. Determine (i) the no-load voltage, (ii) the actual input voltage at the high side, (iii) the high-side current, (iv) the input impedance. **(10)**

(c) A 50-kW, 440 V, 50 Hz six-pole induction motor has a slip of 6 percent when operating at full-load conditions. At full-load conditions, the friction and windage losses are 300 W and the core losses are 600 W. Find the following values for full-load conditions: **(12.5)**

(i) The shaft speed n_m
(ii) The output power in watts
(iii) The load torque
(iv) The induced torque
(v) The rotor frequency

4. (a) With detailed diagrams, explain how a three-phase supply in an induction motor can create a rotating magnetic field in the stator. **(15)**

Contd P/3

EEE 165 (WRE)

Contd... Q. No. 4

(b) A 208 V, two-pole, 60 Hz, Y-connected wound-rotor induction motor is rated at 15 hp. Its equivalent circuit components are: **(16)**

$R_1 = 0.2\ \Omega$ $R_2 = 0.12\ \Omega$ $X_M = 15\ \Omega$

$X_1 = 0.41\ \Omega$ $X_2 = 0.41\ \Omega$

$P_{mech} = 250$ 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}

(vii) The overall machine efficiency

(viii) The motor speed in rpm and radians per second

(c) Compare the magnetization curves of an induction motor and a transformer. **(4)**

SECTION – B

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

5. (a) The current entering the positive terminal of a device is $i(t) = 3e^{-2t}$ A and the voltage across the device is $v(t) = 5\frac{di}{dt}$ V. **(17)**

(i) Find the charge delivered to the device between t = 0 and t = 2s.

(ii) Calculate the power absorbed at t = 1s.

(iii) Determine the energy absorbed in 3s.

(b) Find R_{ab} in the circuit shown in figure 5(b). **(18)**

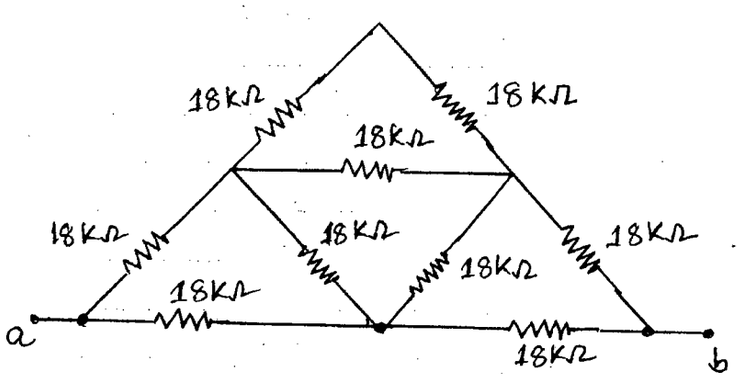

Figure for question no. 5(b)

EEE 165 (WRE)

6. (a) Use nodal analysis method to find v_0 in the circuit shown in figure 6(a). **(17)**

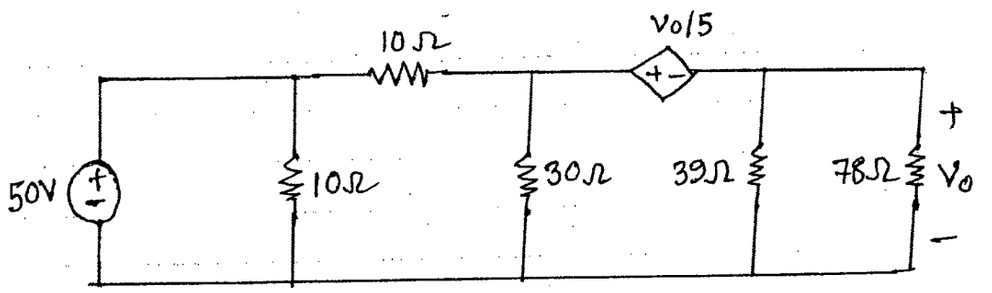

Figure for question no. 6 (a)

(b) Find v_x and i_x in the circuit shown in figure 6(b), using mesh analysis. **(18)**

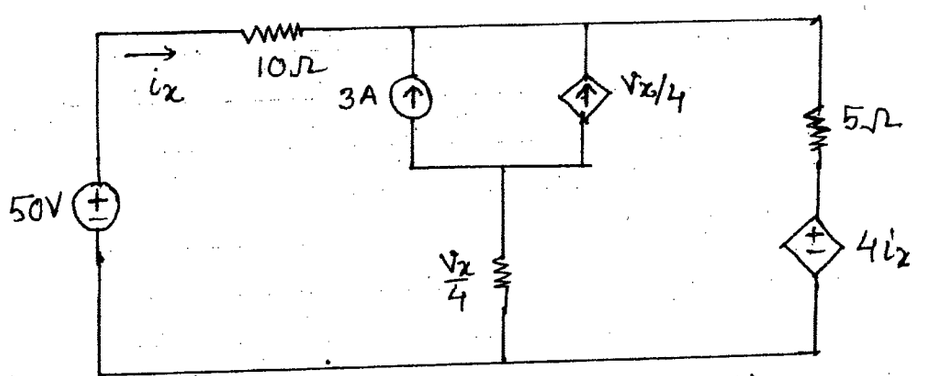

Figure for question no. 6(b)

7. (a) Find v(t) and i(t) for the circuit shown in figure 7(a). **(13)**

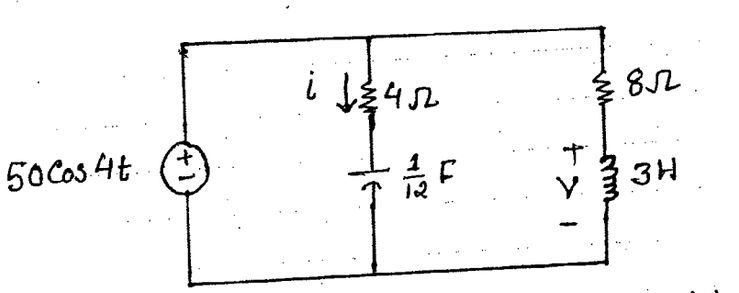

Figure for question. no. 7 (a)

(b) Given, $v(t) = V_m \cos(\omega t + \theta_v)$ and $i(t) = I_m \cos(\omega t + \theta_i)$, show that average power, P is given by $P = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i)$. **(12)**

Contd P/5

EEE 165 (WRE)

Contd... Q. No. 7

(c) Obtain the rms value of the current waveform shown in figure 7(c). If this current is passed through a 2-Ω resistor, find the average power absorbed by the resistor. **(10)**

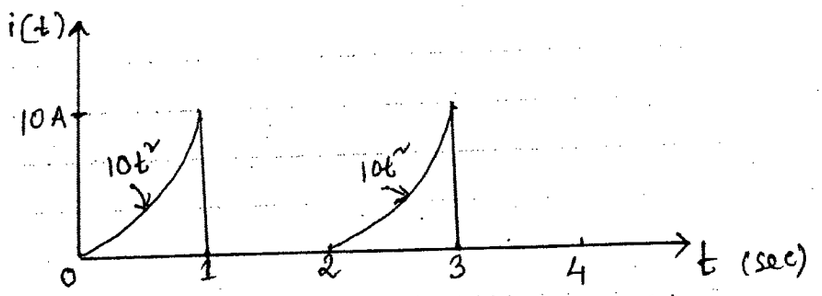

Figure for question no. 7(c)

8. (a) For the circuit shown in figure 8(a), calculate– **(18)**

   (i) The power factor with respect to the source.

   (ii) The average power, reactive power, apparent power and complex power of the source.

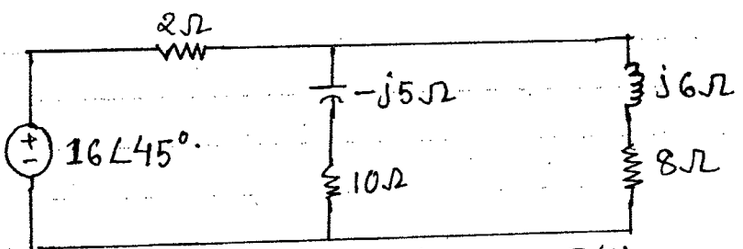

Figure for question. no 8(a)

(b) An 880 VA, 220 V, 50 Hz load has a power factor of 0.8 lagging. What value of parallel capacitance will correct the load power factor to unity? **(17)**
