L-2/T-2/CSE Date : 01/01/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **EEE 269** (Electrical Drives and Instrumentation)

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) Prove that "Three phase power can be measured using two wattmeters". **(15)**

(b) The three phase load given in Figure for Q. 1(b) is fed by a balanced three phase system having V_{ab} = 230 V and positive phase sequence. Find the total power of the system using two wattmeter method. Verify the result by calculating the total power from the individual power of each phase. **(20)**

2. (a) Briefly describe the short circuit and open circuit tests of a transformer. **(17)**

(b) A 20 kVA, 20000/480 V, 50 Hz distribution transformer is tested with the following results: **(18)**

Open Circuit Test (measured from the secondary side)	Short Circuit Test (measured from primary side)
V_{oc} = 480 V	V_{sc} = 1130 V
I_{oc} = 1.60 A	I_{sc} = 1.00 A
P_{oc} = 305 W	P_{sc} = 260 W

Calculate the full-load voltage regulation and efficiency at 0.8 leading power factor. Also draw the phasor diagram of the transformer at same condition.

3. (a) Draw the per phase equivalent circuit of a 3-phase induction motor with rotor losses and P_{conv} separated. Mention the origin of each component in the equivalent circuit. Where, P_{conv} = Power converted to mechanical power. **(10)**

(b) Briefly describe the important information that can be obtained from the torque-speed characteristics of an induction motor. **(10)**

Contd P/2

EEE 269

Contd. Q. No. 3

(c) A 460 V, 25 hp, 50 Hz, four pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator circuit: **(15)**

$R_1 = 0.714\ \Omega$, $R_2 = 0.33\ \Omega$

$X_1 = 1.714\ \Omega$, $X_2 = 0.56\ \Omega$ and $X_M = 0.56\ \Omega$

The combined rotational and core losses are 1100 W. For a rotor slip of 2.2 percent at the rated voltage and rated frequency, find the motor's

(i) P_{conv} and P_{out}

(ii) τ_{ind} and τ_{load}

4. (a) Deriving the terminal characteristics prove that a series DC motor runs in infinite speed when torque is zero. **(15)**

(b) A 50 hp, 250 V, 1200 rpm dc shunt motor with compensating winding has an armature resistance of 0.07 Ω. Its field circuit has a total resistance $R_{adj} + R_F$ of 60 Ω which produces a no-load speed of 1200 rpm. **(20)**

(i) Find the speed of the motor when input current in 100 A, 250 A and 500 A.

(ii) Draw the torque-speed characteristics of this motor.

SECTION – B

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

5. (a) a 208-Ø, 45 KVA, 0.8 ~~PF-LEADING~~, Δ-~~CONNECTED~~, 60 Hz synchronous motor has a synchronous reactance of 2.5 Ω and a negligible armature resistance. Its friction and windage losses are 1.[illegible] kW and its core losses are 1.0 kW. The motor is supplying a 15-hp load with an initial power factor of 0.85 lagging. **(20)**

(i) Sketch the initial phasor diagram of this motor and find the values of the internal generated voltage and the armature current.

(ii) If the motor flux is increased by 20 percent, sketch the new phasor diagram of the motor. What are the internal generated, armature current, and power factor of the motor now?

(b) Explain with phasor diagram, the effect of load changes on a synchronous motor. **(15)**

6. (a) Derive the expression of output voltage for an instrumentation amplifier. **(10)**

(b) A barium litanate pickup has the dimension of 5 mm × 5 mm × 1.25 mm. The force acting on it is 5 N. The charge sensitivity of barium titanate is 150 pC/N and its permittivity is 12.5×10^{-9} F/m. Its modulus of elasticity is 12×10^{6} N/m^2. Calculate the strain, charge, and capacitance. **(15)**

(c) Explain the operating principle of a digital frequency meter. **(10)**

Contd P/3

7. (a) What are the possible reasons for the failure of voltage buildup in a shunt DC generator? **(7)**

(b) Briefly describe the Ward-Leonard system of DC motor speed control. **(10)**

(c) A 50 hp, 220 V, 1130 rpm shunt DC motor has a rated armature current of 150 A and rated field current of 5.5 A. During blocked rotor condition, an armature voltage of 10.2 V produces 155 A of current flow and a field voltage of 220 V produces a field current of 7 A. At no load, the terminal voltage is equal to 245 V, armature current is 14.5 A, field current is 4.7 A, and the speed of the motor is 1000 rpm. Calculate the efficiency of the motor. **(18)**

8. (a) Draw the power flow diagram of a DC shunt generator. **(7)**

(b) For the 240 V, 50 Hz balanced 3-phase system as given in Fig. 8(b), calculate the line loss. **(14)**

(c) Figure 8(c) shows a 120 V, 50 Hz balanced 3-phase system, find the phase current in each phase. **(14)**

Shubhra Kanti 19/12/12

L-2/T-2/CSE **Date : 18/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **CSE 209** (Digital Electronics and Pulse Techniques)

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**.

(The symbols in the questions have their usual meanings)

1. For the DTL gate shown in Fig. 1, assume $V_{BE(sat)} = 0.8$ V, $V_{CE(sat)} = 0.2$ V, and cut-in voltage, $V_\gamma = 0.5$ V for the transistor. The drop across a conducting diode is 0.7 V and its cut-in voltage, V_γ is 0.6 V. The inputs of this gate are obtained from the output of similar gates.

   (i) Verify that the gate functions as a positive NAND and calculate $h_{FE(min)}$ for an unloaded gate. **(7+4=11)**

   (ii) Calculate NM(0) and NM(1). **(3+3=6)**

   (iii) If $h_{FE} = 35$, calculate the fan-out, N. **(5)**

   (iv) Find out the average power dissipated by the gate considering that fan-out N. **(6)**

   (v) Now, consider that you have 5 transistors with h_{FE} = 2, 5, 20, 30 and 35 respectively and for some safety reasons, the maximum number of fan-out allowed for the NAND gate of Fig. 1 is 11. Find out the transistors which will satisfy this restriction. **(7)**

2. (a) For the ECL gate shown in Fig. 2(a),

   (i) Calculate the logic levels at output Y. Assume that $V_{BE(active)} = 0.7$ V. To find the drop across an emitter follower when it behaves as a diode assume a piecewise linear diode model with $V_\gamma = 0.6$ V and $R_f = 20\ \Omega$. **(10)**

   (ii) Find the noise margins. **(4)**

   (iii) Verify that none of the transistors goes into saturation. **(5)**

   (iv) Calculate R so that $Y' = \overline{Y}$. **(5)**

   (v) Find the average power taken from the power source. **(5)**

   (b) Implement the function $f = ab + bc + ca$ using a 4 × 2 (4 words by 2 bits) NMOS ROM. You may use additional devices if required. **(6)**

Contd P/2

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3. (a) Draw a circuit for the function $f = a \oplus b \oplus c$ using only 2:1 MUXs. Construct the MUXs using CMOS transmission gates. Assume that complemented inputs are available. **(9)**

(b) Construct the CMOS logic gate for the function $f = \overline{a(bc+d)+e}$. **(8)**

(c) For an enhancement NMOS having a threshold voltage, V_t = 1V, draw the I_{ds} vs V_{ds} characteristic curves for different V_{gs} (=-1V, 0V, 1V, 2V, 3V). Draw the same curves for a depletion NMOS with a threshold voltage, V_t = -1V. **(5+5)**

(d) Draw the NMOS inverter circuit with **(8)**

- (i) Resistor Load
- (ii) Enhancement Load
- (iii) Depletion Load
- (iv) PMOS Load

4. (a) Draw a 6 - MOSFET static RAM cell with Read/Write amplifiers. Explain the operation of the circuit when you write a zero in the cell and then read it. **(8+8)**

(b) What are the advantages of using BiCMOS logic gates over BJT and CMOS logic gates? Draw the BiCMOS NAND gate. **(4+5)**

(c) Draw the circuit for a two-phase ratioless dynamic NMOS shift-register stage with clock waveforms. **(6)**

(d) What is the significance of $h_{FE(min)}$ for logic gates that use BJT. **(4)**

SECTION – B

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

5. (a) Draw the output waveshape V_0 for the circuit in Figure 5(a) when input V_i is a 10 V peak to peak sine wave with a time period T. Assume that all the diodes are ideal. **(10)**

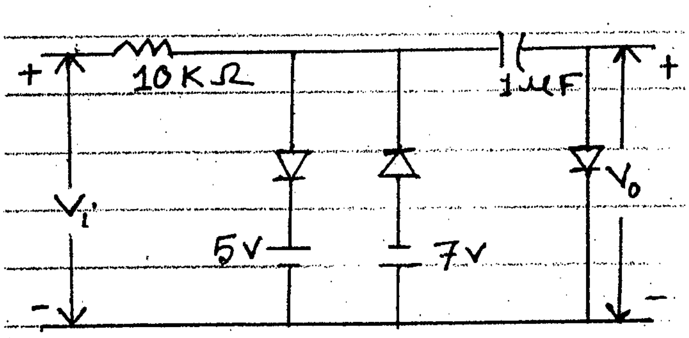

Figure 5(a)

CSE 209

Contd Q. No. 5

(b) Explain the meaning of the term linear waveshaping. What is the special place occupied by the sinusoidal waveform in linear waveshaping? **(2+2=4)**

(c) Draw two circuits that can be used to convert sinusoidal wave to square wave. **(8)**

(d) An asymmetrical square wave with $T_1 = 1$ msec and $T_2 = 1$ usec has an amplitude of 10 V. This signal is applied to the clamper circuit of Figure 5(d) in which $R_f = 50\ \Omega$, $R = 50\ k\Omega$ and $R_s = 0$. Assume that the capacitor C is arbitrarily large, so that the output is a square wave without tilt. Find where, on the waveform, the zero level is located. **(6)**

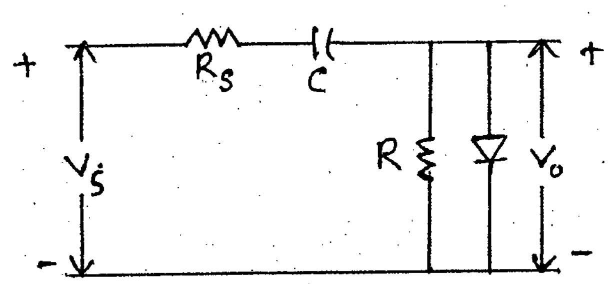

Figure 5(d)

(e) Draw the output waveshape V_0 for the circuit in Figure 5(e) when input V_i is a sinusoidal wave. Assume that the diode is ideal. **(7)**

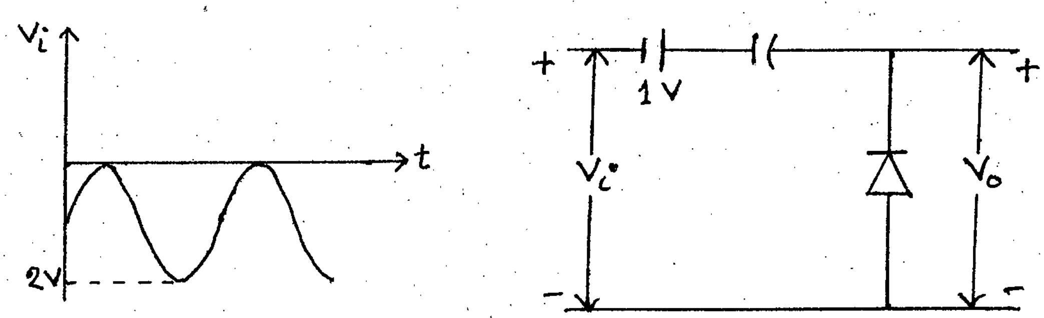

Figure 5(e)

6. (a) For a high pass RC circuit if the input is a pulse wave with pulse width t_p,
   - (i) Find the output equation. **(5)**
   - (ii) Find out the condition when the output will be 50% of the input. **(2)**
   - (iii) If $C = 10\ \mu F$, $R = 2\ k\Omega$ and $t_p = 0.02$ s draw the output waveform. **(3)**

(b) In a high pass RC circuit we want to pass a 2 ms sweep with less than 0.1% attenuation from linearity, what should be the value of RC? **(3)**

(c) Briefly describe the operation of dual slope A/D converter. **(7)**

(d) Draw the output waveshape V_0 for the clamping circuit of Figure 6(d) for the given input V_s. Given that $R_s = R_f = 100\ \Omega$, $R_r = \infty$, $R = 10\ k\Omega$, $C = 1\mu F$, $V_\gamma = 0V$. Assume capacitor's initial voltage = 1V. **(15)**

Contd P/4

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Contd Q. No. 6(d)

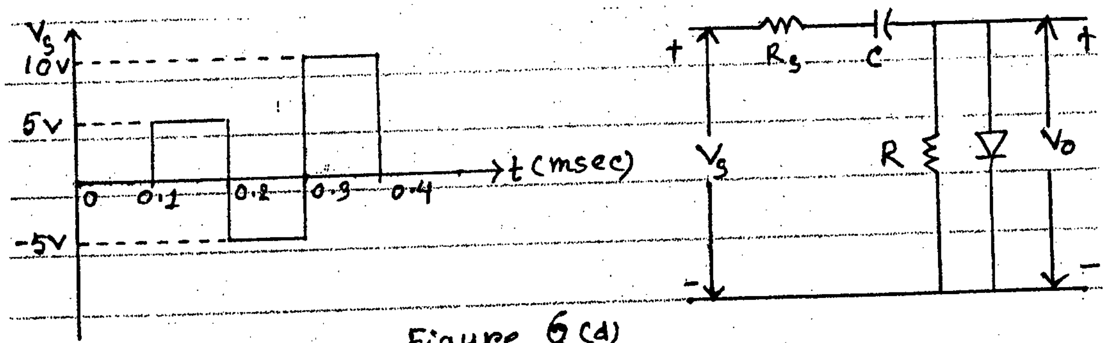

Figure 6(d)

7. (a) A square wave (asymmetrical), whose peak to peak amplitude is 2V volt, extends ±V with respect to ground. The duration of the positive section is T_1 and the negative section is T_2. If this waveform is impressed upon a high pass RC circuit, what are the steady state maximum and minimum values of the output waveform? **(10)**

(b) Describe briefly (any one): **(2)**

(i) Voltage limiters

(ii) DC restorer

(iii) Blocking capacitor.

(c) For the circuit of Figure 7(c) find V_1, V_2, α, β. **(13)**

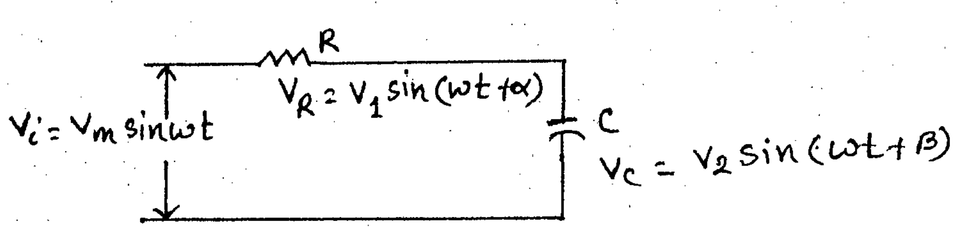

Figure 7(c)

(d) The limited ramp of Figure 7(d) is applied to a low pass RC circuit. Draw, to scale, the output waveform, when T = RC. **(10)**

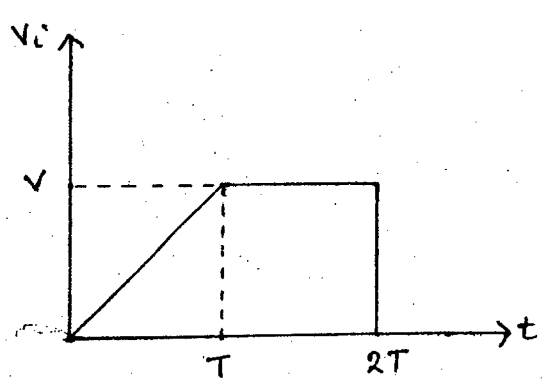

Figure 7(d)

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8. (a) Design a circuit to generate the waveshape of Figure 8(a)(i). Then modify the circuit so that it outputs the waveshape of Figure 8(a)(ii). You should show the calculations. **(10+5=15)**

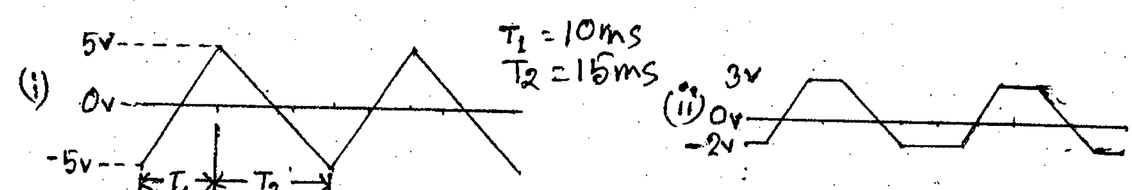

Figure 8(a)

(b) Design N-bit D/A converter so that its output $V_0 \propto OD$, where $OD = S_{N-1}8^{N-1} + \ldots\ldots + S_0 8^0$. You can only use resistance values whose ratios are 1 or multiple of 2. You can use more than one OP AMPs. Mention the number of OP AMPs needed for your design. **(10)**

(c) Determine the value of 'r' if the D/A converter of Figure 8(c) takes input in BCD format. **(10)**

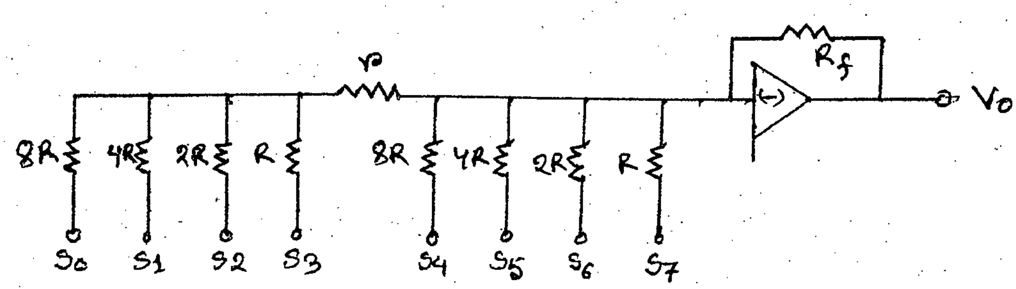

Figure 8(c)

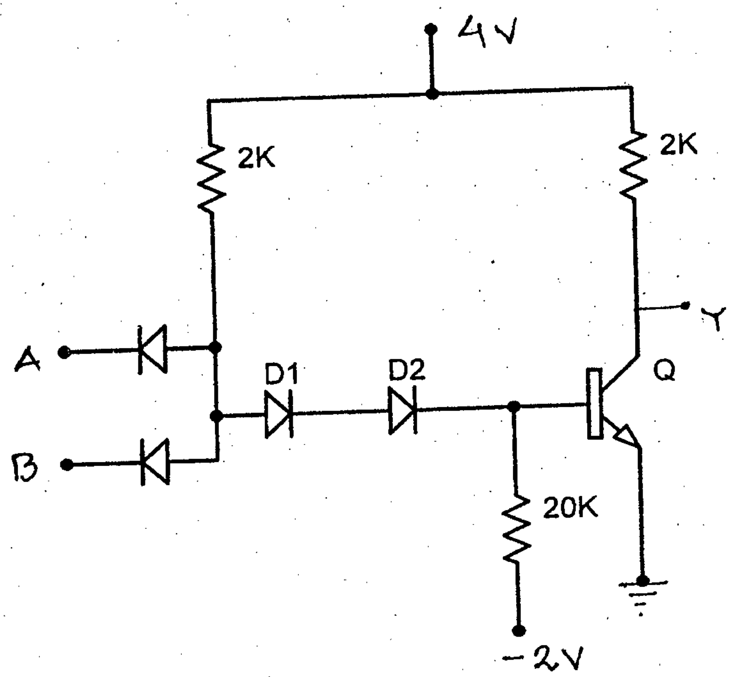

Fig. 1 for Question 1

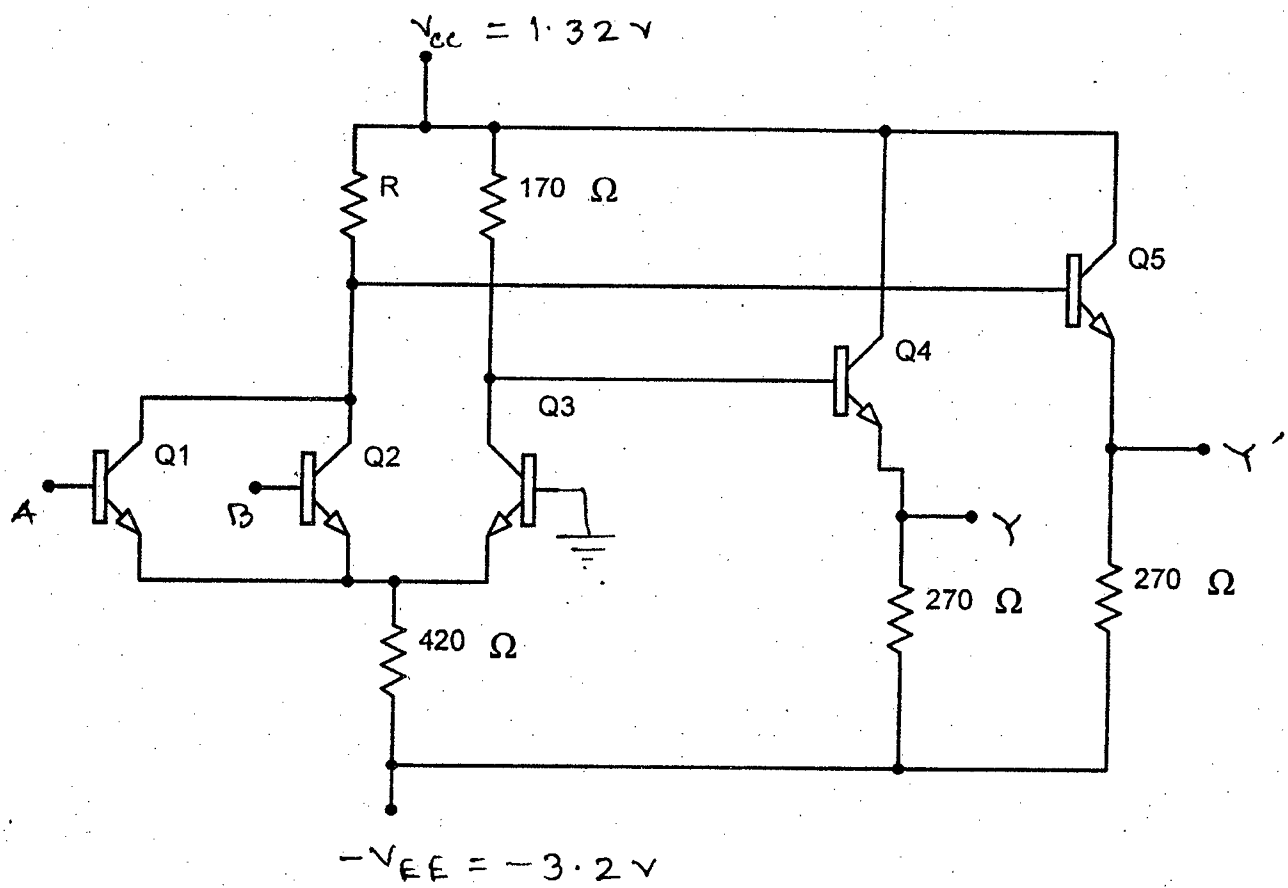

Fig. 2(a) for Question 2.(a)

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L-2/T-2/CSE **Date : 01/01/2013**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **EEE 269** (Electrical Drives and Instrumentation)

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) Prove that "Three phase power can be measured using two wattmeters". **(15)**

(b) The three phase load given in Figure for Q. 1(b) is fed by a balanced three phase system having V_{ab} = 230 V and positive phase sequence. Find the total power of the system using two wattmeter method. Verify the result by calculating the total power from the individual power of each phase. **(20)**

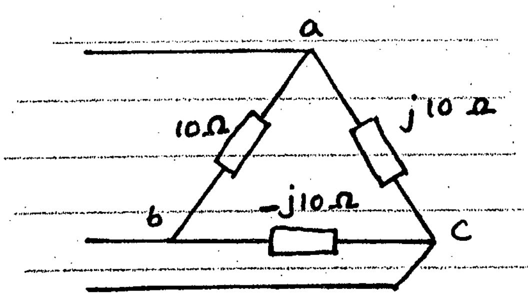

Figure for Q. 1(b)

2. (a) Briefly describe the short circuit and open circuit tests of a transformer. **(17)**

(b) A 20 kVA, 20000/480 V, 50 Hz distribution transformer is tested with the following results: **(18)**

Open Circuit Test (measured from the secondary side)	Short Circuit Test (measured from primary side)
V_{oc} = 480 V	V_{sc} = 1130 V
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Contd P/2

EEE 269

Contd. Q. No. 3

(c) A 460 V, 25 hp, 50 Hz, four pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator circuit: **(15)**

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$X_1 = 1.714\ \Omega$, $X_2 = 0.56\ \Omega$ and $X_M = 0.56\ \Omega$

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(i) P_{conv} and P_{out}

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(i) Find the speed of the motor when input current is 100 A, 250 A and 500 A.

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SECTION – B

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

5. (a) a 208-V, 45 KVA, 0.8 PF-leading, Δ-connected, 60 Hz synchronous motor has a synchronous reactance of 2.5 Ω and a negligible armature resistance. Its friction and windage losses are 1.5 kW and its core losses are 1.0 kW. The motor is supplying a 15-hp load with an initial power factor of 0.85 lagging. **(20)**

(i) Sketch the initial phasor diagram of this motor and find the values of the internal generated voltage and the armature current.

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(b) Explain with phasor diagram, the effect of load changes on a synchronous motor. **(15)**

6. (a) Derive the expression of output voltage for an instrumentation amplifier. **(10)**

(b) A barium titanate pickup has the dimension of 5 mm × 5 mm × 1.25 mm. The force acting on it is 5 N. The charge sensitivity of barium titanate is 150 pC/N and its permittivity is 12.5×10^{-9} F/m. Its modulus of elasticity is 12×10^{6} N/m^2. Calculate the

EEE 269

7. (a) What are the possible reasons for the failure of voltage buildup in a shunt DC generator? **(7)**

(b) Briefly describe the Ward-Leonard system of DC motor speed control. **(10)**

(c) A 50 hp, 220 V, 1130 rpm shunt DC motor has a rated armature current of 150 A and rated field current of 5.5 A. During blocked rotor condition, an armature voltage of 10.2 V produces 155 A of current flow and a field voltage of 220 V produces a field current of 7 A. At no load, the terminal voltage is equal to 245 V, armature current is 14.5 A, field current is 4.7 A, and the speed of the motor is 1000 rpm. Calculate the efficiency of the motor. **(18)**

8. (a) Draw the power flow diagram of a DC shunt generator. **(7)**

(b) For the 240 V, 50 Hz balanced 3-phase system as given in Fig. 8(b), calculate the line loss. **(14)**

(c) Figure 8(c) shows a 120 V, 50 Hz balanced 3-phase system, find the phase current in each phase. **(14)**

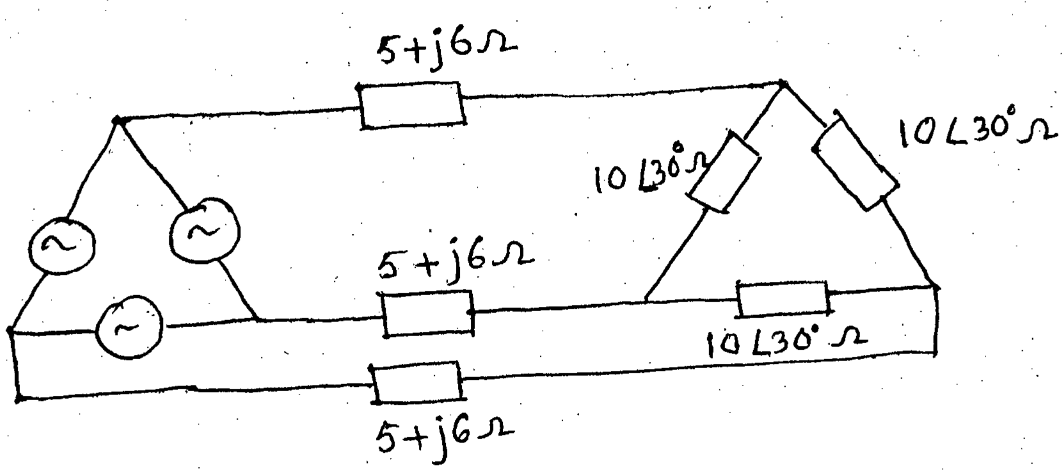

Figure 8(b)

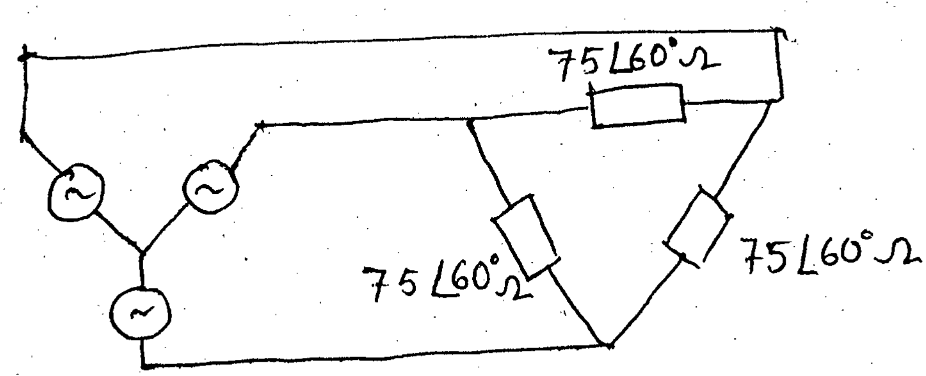

Figure. 8(c)

L-2/T-2/CSE

Date : 08/01/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **MATH 243** (Matrices, Vectors, Fourier Analysis and Laplace Transforms)

Full Marks : 280 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 adjoint method. Then show that $A(\text{adj}A) = |A|I_3$. **(20)**

(b) Solve the following system of equations by reducing the augmented matrix to its canonical form. **(26⅔)**

$$\begin{aligned} x + y + z + w &= 4 \\ 2x - y - z + 3w &= 6 \\ 3x + 4y - 5z + 6w &= -11 \\ 7x - 5y + 7z + w &= 46 \end{aligned}$$

2. (a) Find the eigen values and eigen vectors of the matrix, $A = \begin{pmatrix} 5 & -1 & 1 \\ -1 & 2 & -4 \\ 1 & -4 & 2 \end{pmatrix}$. Is the matrix A diagonalizable? If so, then write down the nonsingular matrix P that diagonalizes A and the corresponding diagonal matrix D. **(30)**

(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 using the above theorem. **(16⅔)**

3. (a) (i) Find a subset of vectors $v_1 = (1, -2, 0, 3)$ $v_2 = (2, -5, -3, 6)$ $v_3 = (1, -1, 3, 1)$, $v_4 = (2, -1, 4, -7)$ and $v_5 = (3, 2, 14, -17)$ that forms a basis for the space spanned by these vectors. (ii) Express each vector not in the basis as a linear combination of the basis vectors. **(20⅔)**

(b) Consider the following two bases of $\mathbf{R}^3$. **(26)**

$E = \{e_1, e_2, e_3\} = \{(1, 0, 0), (0, 1, 0), (0, 0, 1)\}$

and $S = \{u_1, u_2, u_3\} = \{(1, 0, 1), (2, 1, 2), (1, 2, 2)\}$.

(i) Find the transition matrices P from E to S and Q from S to E.

(ii) If $v = (1, 3, 5)$ then find the coordinate vector $[v]_S$ by using transition matrix.

Contd P/2

MATH 243(CSE)

4. (a) Let T: $R^4 \to R^3$ be the linear transformation defined by

$T(x, y, z, t) = (x - y + z + t, x + 2z - t, x + y + 3z - 3t)$.

Find the Kernel and Range of T. Write down a basis and the dimension of KerT and Range T and then verify the dimension theorem. (23⅔)

(b) Write down the geometrical interpretation of dot product and cross product of vectors. For the vectors **A**, **B** and **C** prove that **A** × (**B** × **C**) = (**A** . **C**)**B** − (**A** . **B**)**C**. (23)

SECTION – B

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

5. (a) Evaluate $\int_C \overline{F}.d\overline{r}$, where $\overline{F} = (xz^2 + y, z - y, xy - z)$ and C is the curve $x^2 + y^2 = 9$, $z = 5$ from (0, 3, 5) to (3, 0, 5). (18)

(b) State Gauss divergence theorem. Verify the Gauss divergence theorem for the vector function $\overline{F} = 4x\underline{i} - 2y^2\underline{j} + z^2\underline{k}$ taken over the region bounded by $x^2 + y^2 = 4$, $z = 0$ and $z = 3$. (28⅔)

6. (a) Draw the graph of the following function (16⅔)

$$f(x) = \begin{cases} \dfrac{l}{4}, & -l \le x \le -\dfrac{l}{2} \\ \dfrac{x^2}{l}, & -\dfrac{l}{2} \le x \le \dfrac{l}{2} \\ \dfrac{l}{4}, & \dfrac{l}{2} \le x \le l. \end{cases}$$

Also find the Fourier series of f(x).

(b) Find the Fourier integral of the function (15)

$$f(x) = \begin{cases} \sin x, & 0 \le x \le \pi \\ 0, & x > \pi \text{ and } x < 0 \end{cases}$$

(c) Find F(x) from the integral equation $\int_0^\infty F(x)\cos ux\, dx = \begin{cases} 1-u, & 0 \le u \le 1 \\ 0, & u > 1 \end{cases}$ (15)

7. (a) Find the Fourier transform of $f(x) = \begin{cases} 1-|x|, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$ and hence evaluate

$$\int_0^\infty \frac{\sin^4 \lambda}{\lambda^4} d\lambda.$$ (24)

(b) If L{F(t)} = f(s) then show that $L\left\{\int_0^t F(u)du\right\} = \dfrac{f(s)}{s}$. (8⅔)

(c) Find $L\left\{\dfrac{\sin^2 t}{t^2}\right\}$. (14)

Contd P/3

MATH 243(CSE)

8. (a) Evaluate $L^{-1}\left\{\frac{8}{\left(s^2+1\right)^3}\right\}$ by using convolution theorem. **(16)**

(b) Use Laplace transform

(i) to evaluate $\int_0^\infty e^{-tx^2}\,dx$. **(12)**

(ii) to solve $Y''(t) - tY'(t) + Y(t) = 1$ given that $Y(0) = 1$ and $Y'(0) = 2$. **(18⅔)**
