L-2/T-1/EEE **Date : 03/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **EEE 211** (Continuous Signals and Linear Systems)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

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) What is meant by orthogonal Signals? For the functions shown in Fig. for Q. No. 1(a), (i) show that the functions form an orthogonal set, (ii) determine T that makes the three functions orthonormal. **(12)**

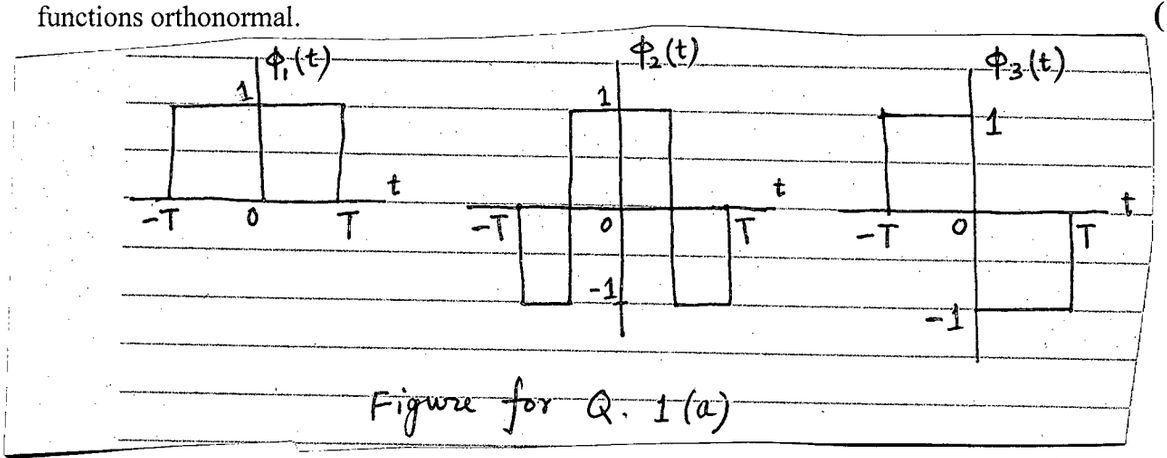

Figure for Q. 1(a)

(b) What is a distortionless LTI system? Find the relation between the Fourier series coefficients of input and output of a distortionless LTI system. **(8)**

(c) Suppose that we have an LTI system with input x(t), output y(t) and frequency response H(jw), where

$$H(j\omega)=\begin{cases}1 \ for \ |\omega|\le 3\pi \\ 0 \quad otherwise\end{cases}$$

Further suppose that the input is given by

$$x(t)=1+2\cos 2\pi t+\cos 4\pi t+\frac{1}{2}\cos 6\pi t\ .$$

Find the exponential Fourier series representation of x(t). Use this representation is order to find the response y(t) of the system to the input x(t). Plot the frequency spectra of x(t) and y(t). **(15)**

2. (a) Derive the perseval's relation of energy for an aperiodic signal. **(7)**

(b) For an electrical network system shown in Fig. for Q. No. 2(b),

$h(t)=\frac{1}{RC}e^{-1/RC}u(t)$. Using frequency domain method, find y(t) when x(t) = Vu(t). Also, plot h(t), x(t), and y(t). **(13)**

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Contd ... Q. No. 2(b)

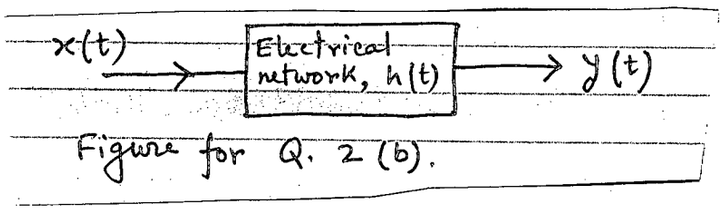

Figure for Q. 2 (b).

(c) In natural sampling, the signal x(t) is multiplied by a train of rectangular pulses, as shown in figure for Q. No. 2(c). (i) Find and sketch the spectrum of $x_s(t)$, (ii) can x(t) be recovered without any distortion? **(15)**

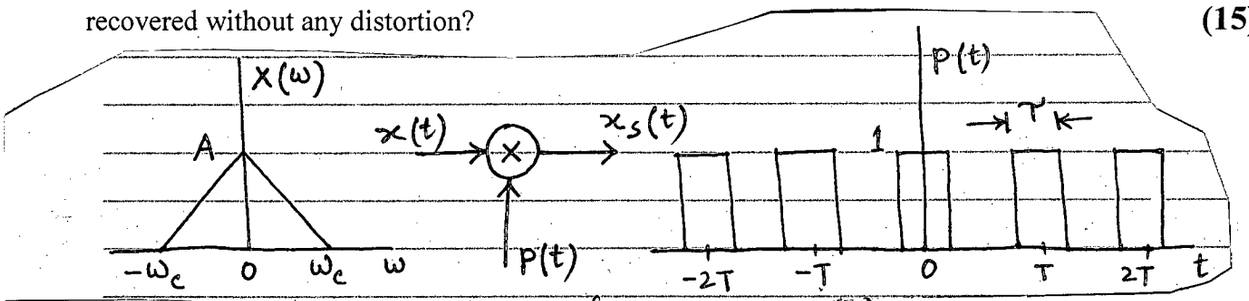

Figure for Q. no. 2(c)

3. (a) Find the s-domain equivalent circuit for the circuit shown in Fig. for Q. No. 3(a) and find y(t) when x(t) = (cost)u(t). Assume that $v_C(0^-) = 1$ V and $i_L(0^-) = 2$ A. **(17)**

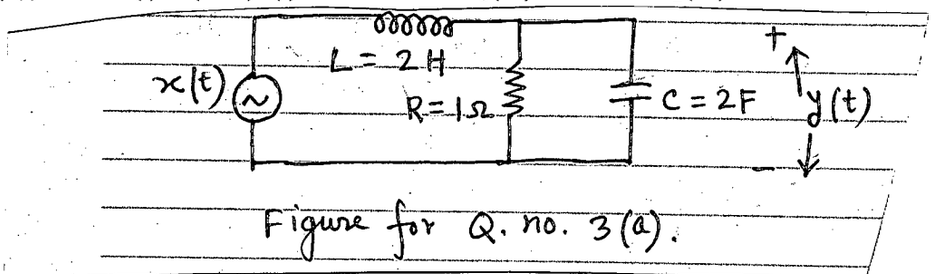

Figure for Q. no. 3(a).

(b) Suppose that we have the causal system with input x(t) and output y(t) formed by the interconnection of two causal LTI systems as shown in Fig. for Q. No. 3(b). The system functions be

$$H_1(s) = \frac{1}{s^2 + bs + (b-2)} \quad and \quad H_2(s) = -1,$$

where b be a real constant. (i) Find the system function H(s) of the overall system, (ii) Determine the values of the parameter b for the which the system is stable. **(18)**

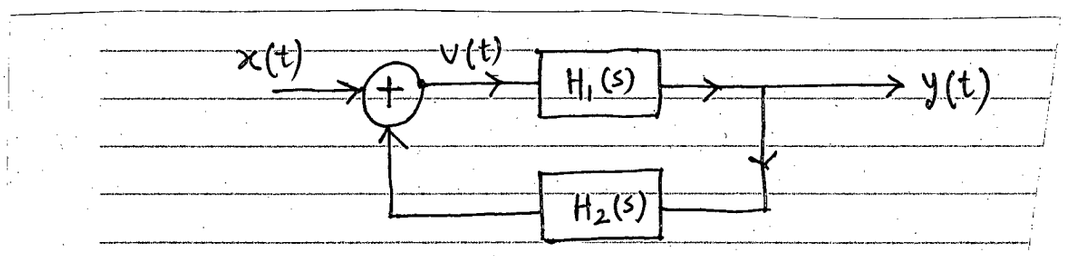

Figure for Q. no. 3(b).

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4. (a) Calculate the trigonometric Fourier series coefficient for the signal

$$x(t) = 3 + \cos\left(4t + \frac{\pi}{4}\right) + \sin\left(10t + \frac{\pi}{3}\right) \quad \textbf{(12)}$$

(b) The model of an LTIC system is given by

$$y''(t) + 3y'(t) + 2y(t) = 2x'(t) + x(t)$$

Calculate the transfer function and the impulse response h(t) for the system. **(13)**

(c) Determine the Laplace transform of the periodic wave shown in Fig. for Q. No. 4(c). If the period is 2, what is the ROC of the transform? **(10)**

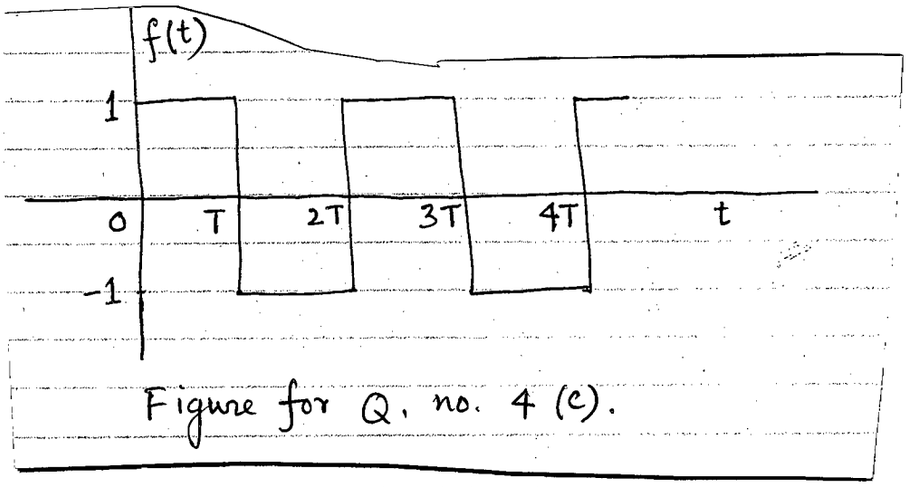

Figure for Q. no. 4 (c).

SECTION – B

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

5. (a) Consider the following signals

$$x_1(t) = 2\cos\left(0.6\sqrt{\pi}t + \tfrac{\pi}{6}\right)$$
$$x_2(t) = \sin\left(1.2\sqrt{\pi}t - \tfrac{\pi}{3}\right)$$

Is the signal x(t) = $x(t) = [x_1(t) + x_2(t)]^2$ periodic? In the case of periodic signal, determine the fundamental period. **(15)**

(b) Determine whether the following signals are power or energy signals or neither. Justify your answer. **(20)**

$$x_1(t) = x\left(4 - \tfrac{1}{2}\right)\left[\delta\left(t + \tfrac{3}{2}\right) - \delta\left(t - \tfrac{3}{2}\right)\right]$$
$$x_2(t) = \sum_{k=-1}^{1} u(2x(t) - k)$$

Where the signal x(t) is given in Fig. for Q. 5(b).

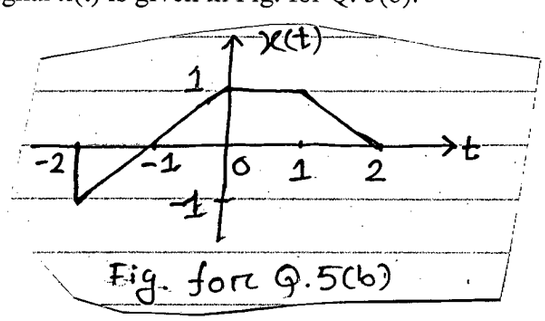

Fig. for Q.5(b)

Contd P/4

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6. (a) Consider an LTI system whose response to the signal $x_1(t) = u(t) - u(t-1)$ is the signal $y_1(t)$ illustrated in Fig. for Q. 6(a). Determine and sketch the response of the system to the input $x_2(t)$ shown in Fig. for Q. 6(a). **(20)**

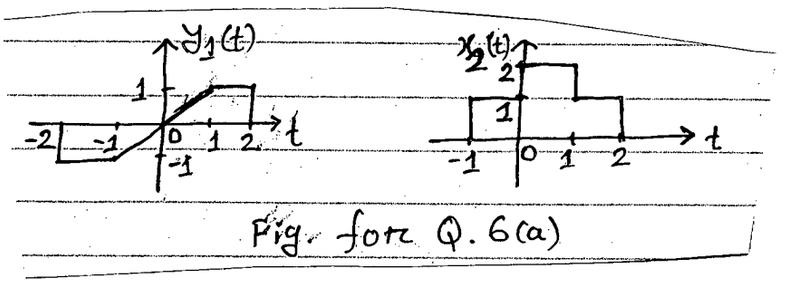

Fig. for Q. 6(a)

(b) Consider the system shown in Fig. for Q. 6(b). Determine whether it is (a) time-invarient, (b) memoryless, (c) causal, (d) invertible, (e) stable or not. **(15)**

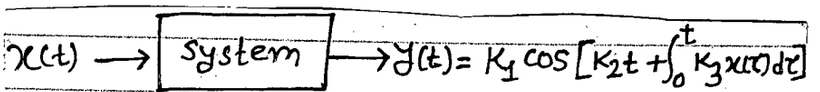

Fig. for Q. 6(b)

where, k_1, k_2, and k_3 are constants.

7. (a) The input and impulse response of an LTI system are denoted by x(t) and h(t), respectively, and are shown in Fig. for Q. 7(a). Using the graphical interpretation of convolution, obtain the output of the system, y(t). Also, write the analytical expression of y(t). **(20)**

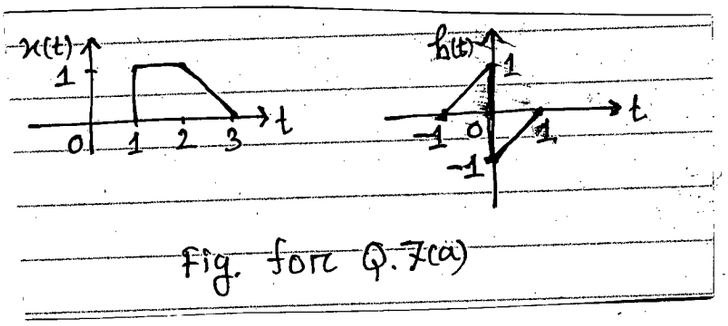

Fig. for Q. 7(a)

(b) The input signal of the LTI system shown in Fig. for Q. 7(b) is the following:

$x(t) = u(t) - u(t-2) + \delta(t+1)$

The impulse responses of the subsystems are $h_1(t) = te^{-t}u(t)$, $h_2(t) = e^{-2t}u(t)$. **(15)**

(i) Determine the impulse response h(t) of the overall system.

(ii) Find an equivalent system (same impulse response) configured as a parallel interconnection of two LTI subsystems.

(iii) Determine the output signal y(t).

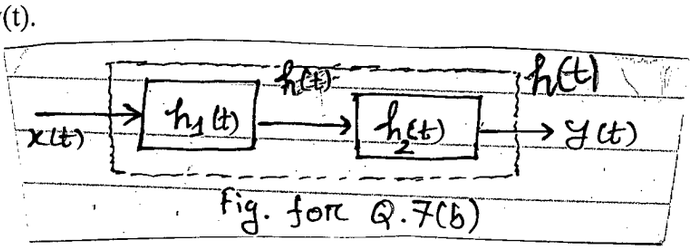

Fig. for Q. 7(b)

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8. (a) Consider the system simulation diagram of Fig. for Q. 8(a). **(20)**

(i) Find the differential equation of the system.

(ii) Using state-variable techniques, find the impulse response (h(t) for the system described by the differential equation obtained in (i).

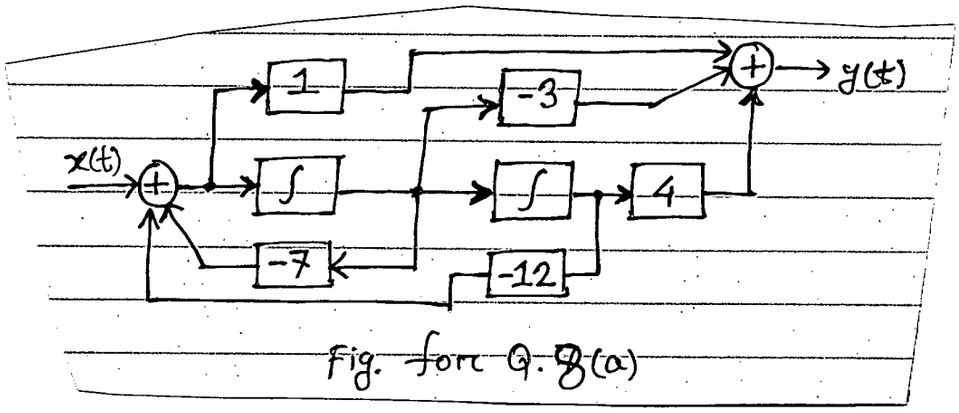

Fig. for Q. 8(a)

(b) For the circuit shown in Fig. for Q. 8(b), write the electrical and analogous mechanical differential equations by using force-current (f – i) analogy. Also draw the f – i analogous mechanical system for the circuit. **(15)**

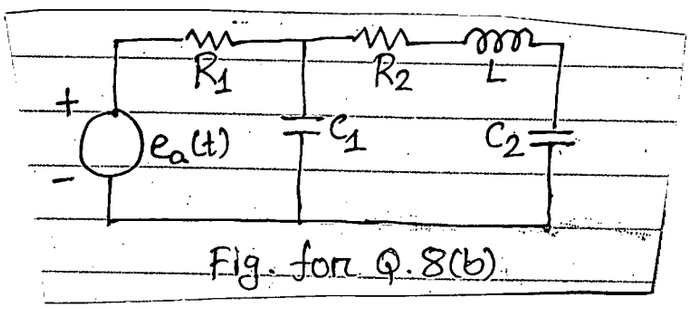

Fig. for Q. 8(b)

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Sub : **EEE 211** (Continuous Signals and Linear Systems)

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SECTION – A

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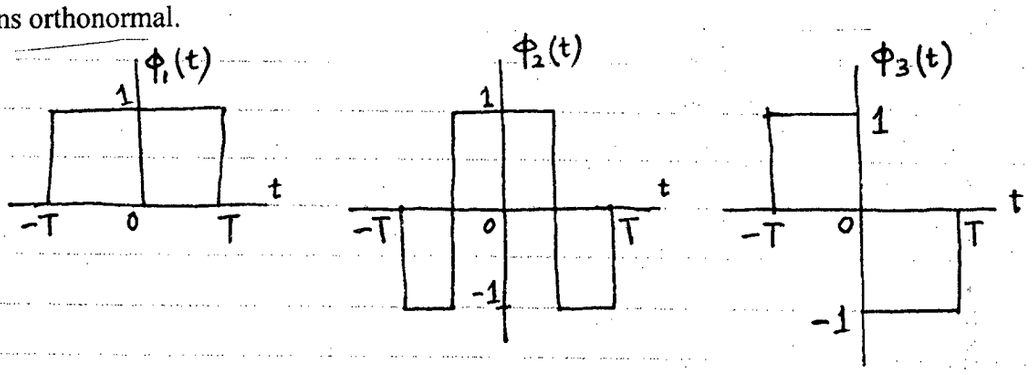

Figure for Q. 1 (a)

(b) What is a distortionless LTI system? Find the relation between the Fourier series coefficients of input and output of a distortionless LTI system. **(8)**

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Contd P/2

EEE 211

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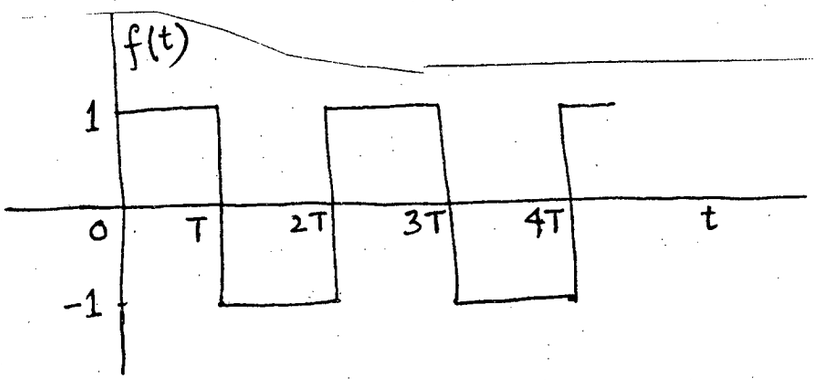

Figure for Q. no. 4 (c).

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$$x_1(t) = x(4 - 1/2)\,[\delta(t + 3/2) - \delta(t - 3/2)]$$
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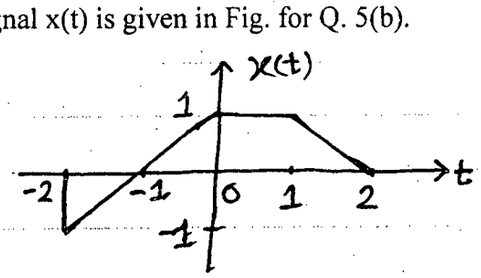

Fig. for Q.5(b)

Contd P/4

EEE 211

8. (a) Consider the system simulation diagram of Fig. for Q. 8(a). **(20)**

(i) Find the differential equation of the system.

(ii) Using state-variable techniques, find the impulse response (h(t) for the system described by the differential equation obtained in (i).

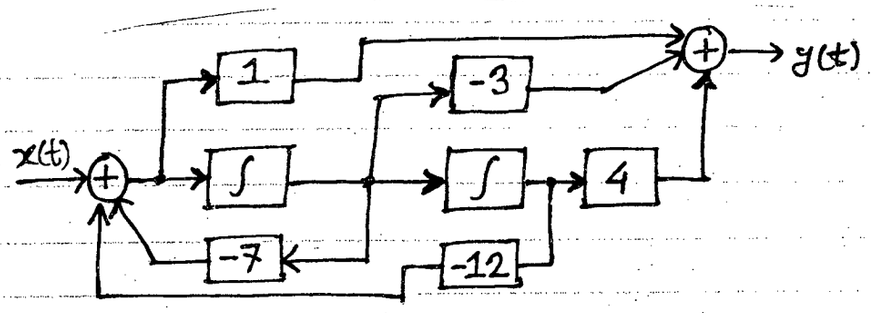

Fig. for Q. 8(a)

(b) For the circuit shown in Fig. for Q. 8(b), write the electrical and analogous mechanical differential equations by using force-current (f – i) analogy. Also draw the f – i analogous mechanical system for the circuit. **(15)**

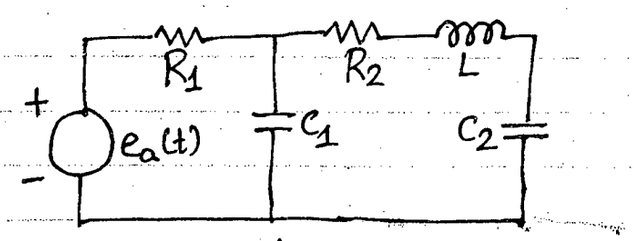

Fig. for Q. 8(b)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **EEE 201** (Electronic Circuits-I)

Full Marks : 210 Time : 3 Hours

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USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Make necessary assumptions, Assume any missing data. The symbols have their usual meanings.

1. (a) Determine the expression of small-signal reistance of diode for the circuit shown in Fog. for Q. No. 1(a). **(10)**

   (b) Assuming ideal diodes in the circuit of Fig. for Q. 1(b), find the value of the labeled voltage and current. **(10)**

   (c) A zener diode in the circuit shown in Fig. for Q. 1(c) is specified to have a zener voltage of 6.8 V at a test current of 5 mA. The incremental resistance of the zener diode is 10 Ω and the knee current is 0.2 mA. The supply voltage V^+ is nominally 10 V but can vary by ± 1V. **(15)**

   (i) (i) Find V_o with no-load and with V^+ at its nominal value.

   (ii) Find the line regulation for $\Delta V^+ = \pm$ 1V and load regulation for ΔI_L = 1mA.

   (iii) What is the minimum value of R_L for which the diode still operates in the breakdown region?

2. (a) Determine the wave-shape of v_o for the circuit shown in Fig. for Q. 2(a). The V_{in} is a sine wave of 20 V (peak) and has a time period of 1 ms. The diode has a 0.7 V drop when conducting for all currents. **(15)**

   (b) (i) Draw the transfer characteristics and drain current versus V_{in} curve for the CMOS circuit shown in Fig. for Q. 2(b) indicating the states of Q_n dn Q_p Assume $R_L = \infty$.

   (ii) For the circuit shown in Fig. for Q. 2(b), $k_n'\left(\frac{W_n}{L_n}\right) = k_p'\left(\frac{W_p}{L_p}\right) = 1mA/v^2$,

   $V_{tn} = |V_{tp}| = 1$ V, R_s= 10 k Ω, R_L = 10 k Ω and V_{DD}=2.5 V. Determine the output voltage for V_{in}= 0 V and + 2.5 V. Assume λ = 0. **(20)**

3. (a) Define the terms (i) threshold voltage and (ii) transconductance in relation to MOSFET. For the devices shown in Fig. for Q. 3(a), $|V_t|$ = 1 V, λ = 0, $\mu_n C_{ox}$ =50 μA/V^2, L = 1 μm and W = 10 μm. Find V_2 and I_2. How do these values change if Q_3 and Q_4 are made to have W = 100 μm? **(15)**

Contd P/2

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Contd ... Q. No. 3(b)

(b) Design the circuit shown in Fig. for Q. 3(b) so that the transistor operates in saturation with V_{SD} biased at 1 V from the edge of the triode region, with I_D = 1 mA and V_D= 3 V, for each of the following two devices (use a 10-μA current in the voltage divider): **(20)**

(i) $|V_t|$ = 1 V and $k'_p\left(\frac{W}{L}\right) = 0.5mA/v^2$

(ii) $|V_t|$ = 2 V and $k'_p\left(\frac{W}{L}\right) = 1.25mA/v^2$

For each case, specify the values of V_G, V_D, V_s, R_1, R_2 and R_D.

4. (a) Given V_{DD} = 5 V and I_{REF} = 100 μA, it is required to design the circuit of Fig. for Q. 4(a) to obtain an output current whose nominal value is 80 μA. Find R if $Q_1$and Q_2 are matched, have channel lengths of 10 μm and channel widths of 100 μm, V_t= 1 V and k'_n= 20 μ A/V^2. What is the lowest possible value of V_o? Assuming V_A 100 V, find the output resistance of the current source. Also find the change in output voltage resulting from a 3-μA change in I_o.

(b) Draw the small signal equivalent circuit for the network shown in Fig. for Q. 4(b). Given that the MOS parameters are q_m= 1 mA/V and r_o = 150 k Ω, find R_{in} , R_o and v_o/v_{in} without and with r_o taken into account.

SECTION – B

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

5. (a) A full-wave rectifier circuit with 1 k Ω load operates from a 220 V (rms), 50 Hz supply through a 5:1 transformer having a center-tapped secondary winding. It uses two diodes that can be modeled to have a 0.7 V drop for all currents. **(15)**

(i) What is the peak voltage of the rectified output?

(ii) For what fraction of a cycle does each diode conduct?

(iii) What is the average output voltage?

(iv) What is the average current in the load?

(b) Consider a bridge-rectifier circuit with a filter capacitor C placed across the load resistor R for the case in which the transformer secondary delivers a sinusoid of 12 V (rms) having a 50 Hz frequency and assuming V_D = 0.7 V and a load resistance R = 100 Ω. Find the value of C that results in a ripple voltage not more than 1 V peak to peak. What is the dc voltage at the output? Find the load current. Find the diode's condition angle. What is the average diode current? What is the peak reverse voltage across each diode? **(20)**

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6. (a) For a common emitter npn transistor in active mode, explan the term "Early effect" with necessary diagrams. Also draw the large-signal equivalent circuit model for a common-emitter npn transistor considering the early effect. **(17)**

   (b) Find the values of V_B, V_E, and V_c for (i) R_B = 100 k Ω, (ii) R_B = 10 k Ω and (iii) R_B = 1 k Ω, for the circuit shown in Fig. for Q. 6(b). Assume β = 100. **(18)**

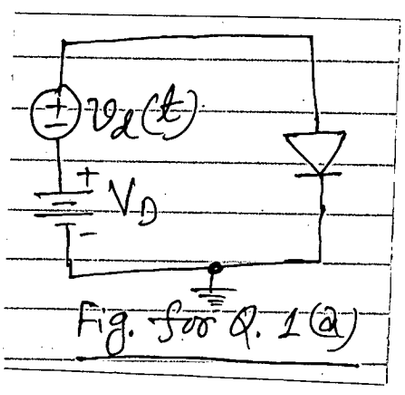
7. (a) Derive the Hybrid n-model and T-model for a bipolar Junction Transistor. **(15)**

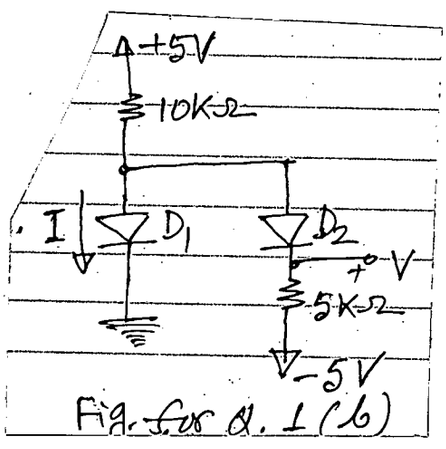
   (b) Find the values of V_1,V_2, V_3, V_4, and V_5 for the circuit shown in Fig. for Q. 7(b). Assume β = 100. **(20)**

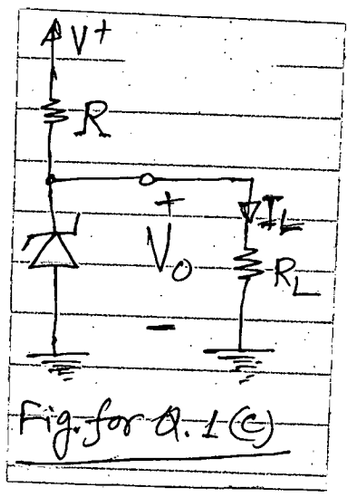
8. (a) For the common-emitter amplifier with an emitter resistance shown in Fig. for Q. 8(a), determine the input resistance (R_{in}), output resistance (R_{out}), voltage gain (A_v), open circuit voltage gain (A_{vo}), overall gain (G_v) and short circuit current gain (A_{is}). **(18)**

   (b) For the emitter-follower circuit shown in Fig. for Q. 8(b) find the following values for β = 40 and β = 200. **(17)**

   (i) V_E and V_B, (ii) the input resistance R_{in}, (iii) the voltage gain v_o/v_{sig}.







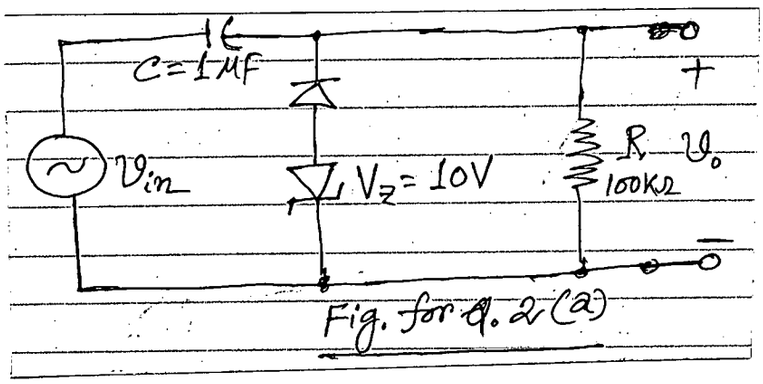


Fig. for Q. 2(a)

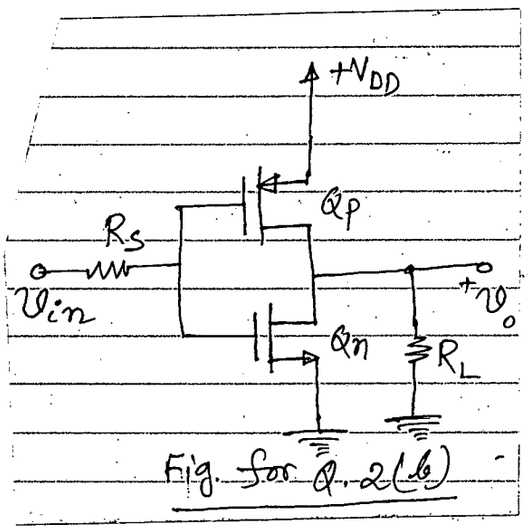


Fig. for Q. 2(b)

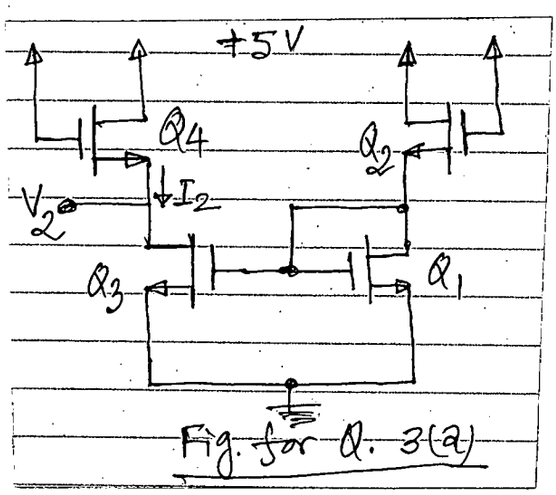


Fig. for Q. 3(a)

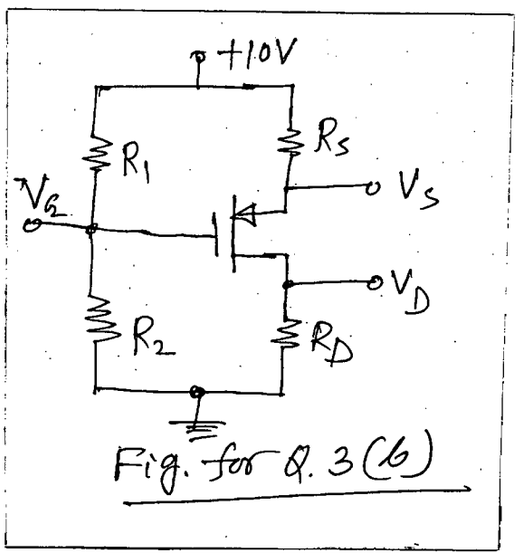


Fig. for Q. 3(b)

4. (a)

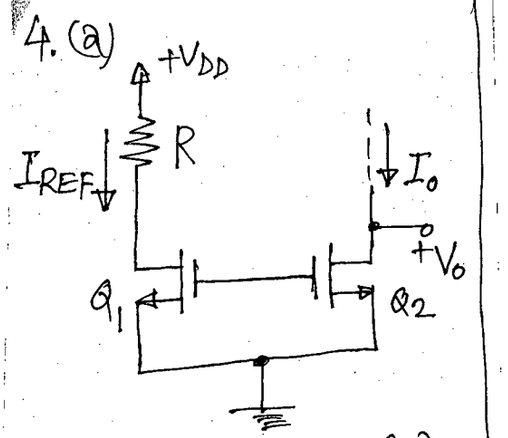


Fig. for Q. 4 (a)

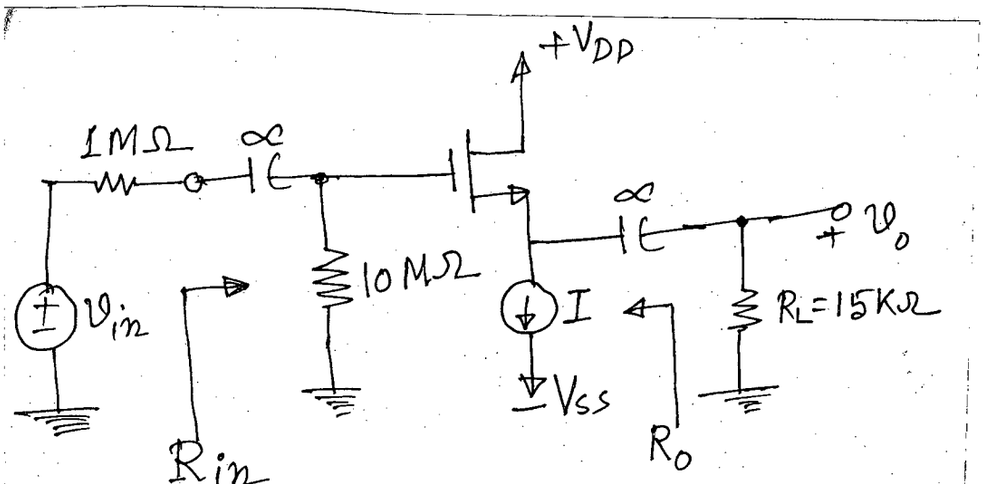


Fig. for Q. 4(b)

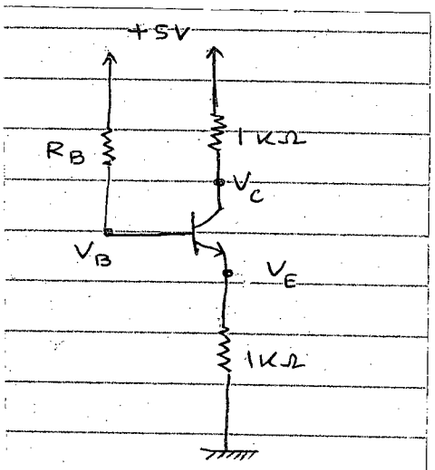


Fig. for Q. 6(b)

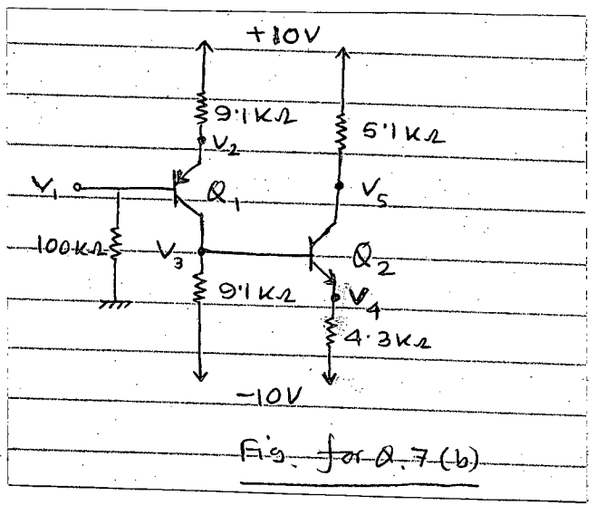


Fig. for Q. 7 (b)

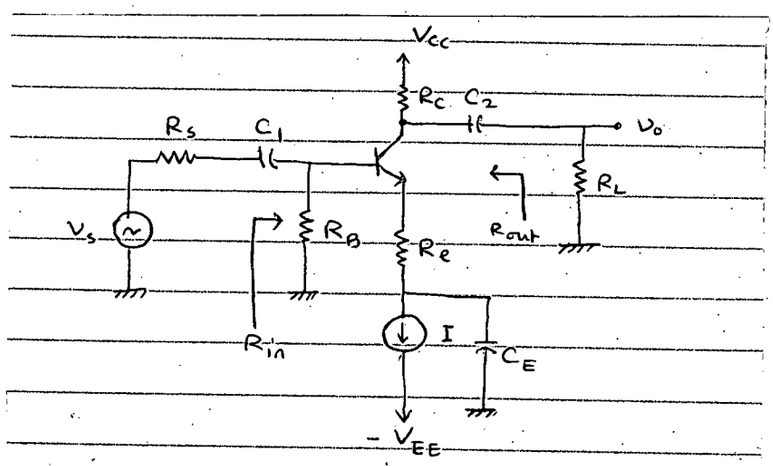


Fig. for Q. 8(a)

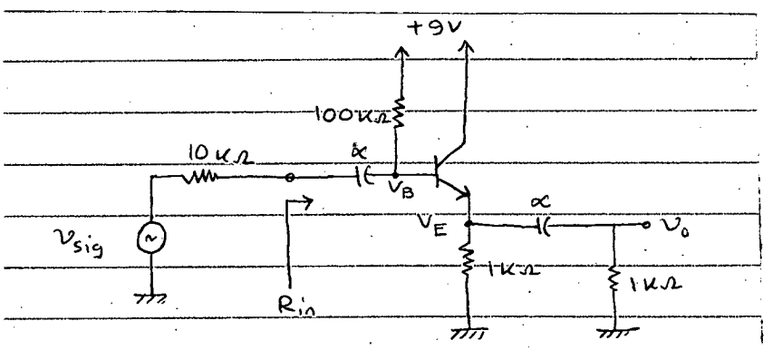


Fig for Q. 8(b)

L-2/T-1/EEE **Date : 18/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **EEE 203** (Energy Conversion I)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What do you mean by 'static', 'alternating', and 'rotating' magnetic field? Explain the significance of rotating magnetic field in rotary machines. **(10)**

   (b) Data from a blocked rotor test, and a DC test on a three-phase, 10 hp, four pole, 208 V, 60 Hz, Δ-connected induction motor are: **(25)**

Blocked Rotor Test (15 Hz)	**DC Test**
$V_{line} = 21.65$ V	$V_{DC} = 15$ V
$I_{line} = 30$ A	$I_{DC} = 30$ A
$P_{3\text{-}phase} = 900$ W	

   Determine R_1, R_2, X_1, X_2 (Assume $X_1:X_2 = 2:3$)

   From no-load test, the magnetizing reactance is found to be 30 Ω.

   The combined rotational loss of the motor is 1 W and constant. Now determine the following when it rotates at a speed of 1764 rpm.

   (i) Stator copper loss

   (ii) Rotor copper loss

   (iii) Input Power

   (iv) Shaft Power

   (v) Shaft Torque

   (vi) Efficiency

2. (a) Explain why a 3-phase induction motor draws high inrush current at starting when supplied from a fixed frequency and rated voltage supply source. **(8)**

   (b) A 460-V, 100-hp, four-pole, Δ-connected, 60-Hz three-phase induction motor has a full-load slip of 5 percent, an efficiency of 90 percent, and a power factor of 0.85 lagging. At start-up, the motor develops 1.9 times the full-load torque but draws 7.5 times the rated current at the rated voltage. This motor is to be started with a reduced voltage starter. Now determine

   (i) required input voltage at motor terminals that will reduce the locked-rotor current to 500% of the rated value

   (ii) locked-rotor current

   (iii) locked-rotor torque

Contd P/2

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Contd ... Q. No. 2

(c) A typical across-the-line magnetic starter is shown in Fig. for Q. 2(c). Explain how the circuit can be used to start and stop the motor. Discuss various protective features of the circuit. **(12)**

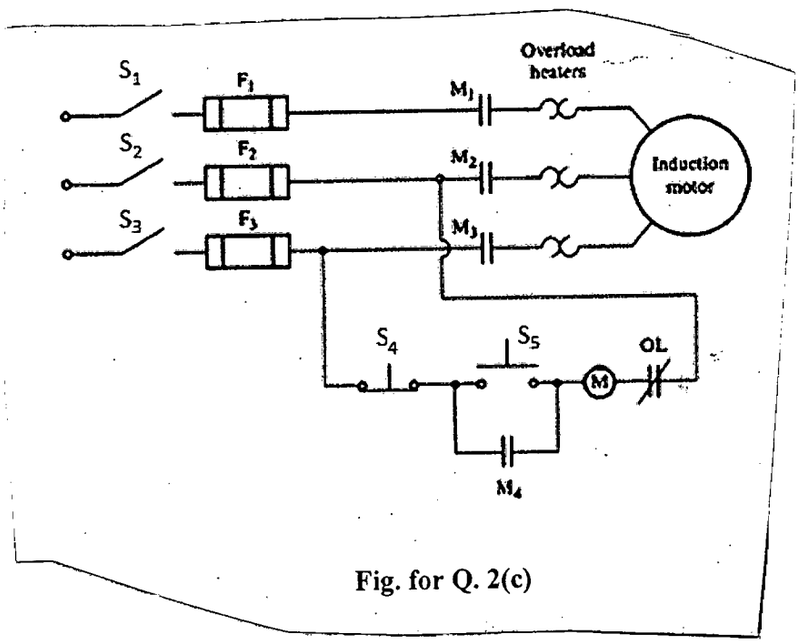

Fig. for Q. 2(c)

3. (a) Define synchronous speed. Why cannot an induction motor operate at synchronous speed? Mention the methods for controlling speed of a squirrel-cage induction motor. Which one is the most popular method and why? **(10)**

(b) A family of torque slip curves for a wye-connected, 400 hp, 2300 V, 12 pole, 60 Hz, wound-rotor induction motor is shown in Fig. for Q. 3(b). Curves A and D indicate the extremes of rheostat adjustment. The ratio of stator turns per phase to rotor turns per phase is 4, and the motor parameters in ohms/phase are: **(15)**

$R_1 = 0.403$ $R_2 = 0.317$

$X_1 = X_2 = 1.32$ $X_m = 35.46$

(i) Determine the range of rotor speeds available by rheostat adjustment, assuming 140% rated torque load on the shaft

(ii) Determine the rheostat resistance required to obtain 260 percent rated torque when starting.

(iii) Determine the rheostat resistance required to obtain 275 percent rated torque when starting.

(c) Briefly describe the process of 'regenerative braking' and 'plugging'. **(10)**

4. (a) A family of magnetization curves for a self-excited induction generator for various prime mover speed is shown in Fig. for Q.4(a). Given that, when the prime mover speed is 1000 rpm, no-load terminal voltage is 200 V. The per-phase capacitance of the capacitor bank is 100 μF:

(i) What is the frequency of generated voltage?

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Contd ... Q. No. 4

(ii) If the prime mover speed increases to 1200 rpm, what will be the terminal voltage?

(iii) Find the critical capacitance at a speed of 1500 rpm.

(b) Prove that, the maximum mechanical power that can be extracted from the wind is 59.3% of the total available power. **(12)**

(c) What is meant by asynchoronous electricity generation? Draw the block diagram for the control system of a wind turbine that generates electricity in asynchronous mode. **(8)**

SECTION – B

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

5. (a) What does the vector group notation DYn-11 mean for a three-phase transformer? What are the required conditions for another three-phase transformer to be paralleled with the above mentioned one? **(10)**

(b) Two single phase transformers (A and B) are to be connected with their primaries and secondaries in parallel, respectively. Transformer A has a rating of 75 KVA, 2300/230V with an equivalent impedance of 1.13 + j2.07 Ω referred to the primary side. The rating for Transformer B is 25 KVA, 2300/230 V with a primary equivalent impedance of 4.15 + j7.1 Ω. The load to be supplied is 400 A at 0.8 pf (lagging). **(25)**

(i) Determine the current supplied by each transformer.

(ii) At what percentage of its rating, would each transformer be operated?

(iii) Determine the no-load circulating current of the system.

6. (a) In the ideal autotransformer of Fig. for 6(a), calculate $\mathbf{I}_1$, $\mathbf{I}_2$, $\mathbf{I}_0$. Find the average power delivered to the load. **(13)**

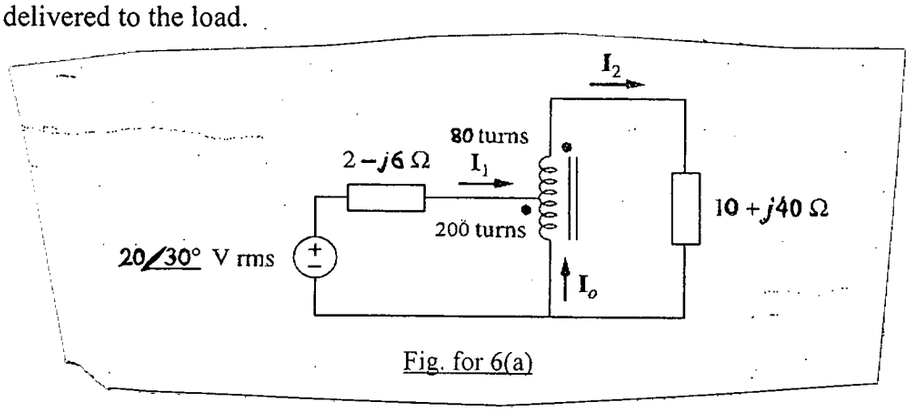

Fig. for 6(a)

(b) A 100-MVA 230/115-KV Δ-Y three phase power transformer has a per unit resistance of 0.015 pu and a per unit reactance of 0.06 pu. The excitation branch elements are R_C = 100 pu and X_M = 20 pu. **(12+10=22)**

(i) If the transformer supplies a load of 80 MVA at 0.8 p.f. leading, draw the phasor diagram of one phase of the transformer. Also, determine the voltage regulation of the transformer.

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(ii) Sketch the equivalent circuit referred to the low-voltage side of one phase of this transformer. Calculate all the transformer impedances referred to the low-voltage side.

7. (a) What is in-rush current? Explain how the problem is associated with the phase angle of the applied voltage. **(10)**

   (b) A 20KVA, 20,000/480-V distribution transformer is tested at rated conditions with the following results: **(25)**

Open-circuit Test (measured from secondary side)	Short-circuit Test (measured from primary side)
Ioc = 1.6 A	Vsc = 1130 V
Poc = 305 W	Psc = 260 W

   Find the per-unit equivalent circuit of this transformer. Also, draw the equivalent circuit referred to the low-voltage side.

8. (a) Explain why the available power output of an open-delta bank is only 57.7% of the original delta-delta bank's rating. **(25)**

   (b) A distribution transformer is rated at 18 KVA, 20,000/480 V and 60 Hz. Can this transformer safety supply 15 KVA to a 415 V load at 50 Hz? Why or why not? **(10)**

Attach this page to your answer script, if you answer to the question no. 3(b) or 4(a)

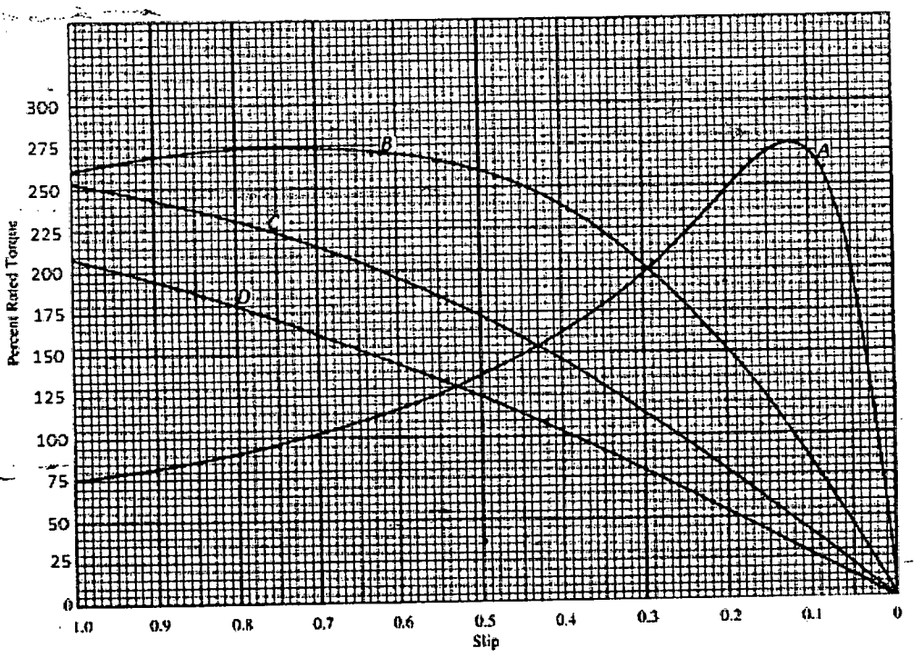


Fig. for Q. 3(b)

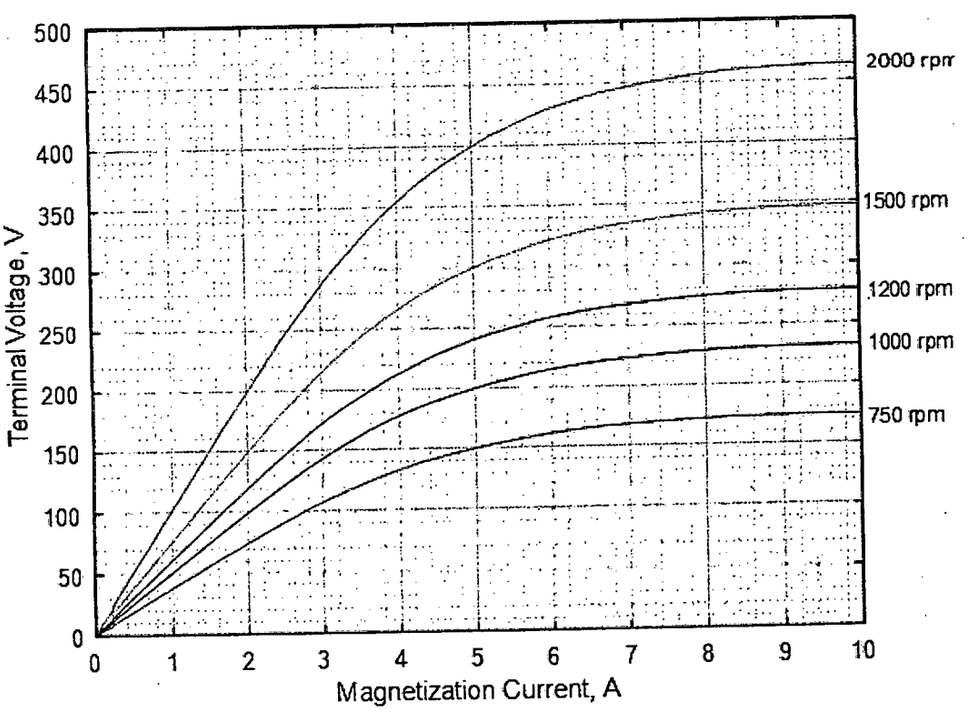


Fig. for Q. 4(a)

L-4/T-1/EEE **Date : 24/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **HUM 135** (English)

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 **Q. No. 1** and any **TWO** from the rest.

1. (a) Explain with reference to the context any **TWO** of the following: **(15)**

(i) "He wears a mask, and his face grows to fit it."

(ii) "This is our island. It's a good island. Until the grown-ups come to fetch us we'll have fun."

(iii) "He was as much a stranger to the stars as were his innocent customers."

(b) Answer any **ONE** of the following: **(15)**

(i) "The Rocking-House Winner" is an insightful portrayal of a society where money is more valued human relationships- do you agree? Justify your stance.

(ii) How did Orwell's guilt and conscience play a vital role in the narrative of "Shooting an Elephant"?

(c) Answer any **THREE** of the following: **(15)**

(i) Why did Paul keep hearing the secret whispers?

(ii) What did the Conch symbolize in "Fire on the Mountain"?

(iii) What impression do you get about the Astrologer?

(iv) Why did the narrator hate the young Buddhist priests in "Shooting an Elephant"?

(v) How did Paul's mother treat her children?

2. (a) Recast and correct any **TEN** of the following sentences: **(15)**

(i) State exchanged his collection of match boxes by some foreign stamps.

(ii) You must guard from bad habits.

(iii) Raisa always insisted to her opinion.

(iv) The man was trembling from cold.

(v) I object to be treated like this.

(vi) She's used to get up early.

(vii) Being in a hurry, the door was left open.

(viii) Shaila was absent one time or two times.

(ix) At the end, they reached the city.

(x) Both of them did not go to school today.

(xi) I came here for learning English.

(xii) I'll need an hour to do that.

Contd P/2

HUM 135
Contd ... Q. No. 2

(b) Give the meaning of and make sentences with any **TEN** of the following words: **(15)**

Admonish, Cogent, Elucidate, Impartible, Meddle, Ominous, Prelude, Reproach, Prolific, Unanimous, Vanity, Bilateral.

3. Amplify any **ONE** of the following: **(30)**

(a) "Our sweetest songs are those that tell of saddest thought."

(b) "Fools admire, but men of sense approve."

4. Write a précis of the following passage with a suitable title: **(30)**

Nature runs as a consistent motif in all of Rabindranath Tagore's oeuvre. He was an environmental pioneer and sought harmony between progress and preservation. He had been eloquent about the exploitation of environment even a century ago. Tagore first became concerned about man's impact on the environment after seeing an oil spill at sea on his way to Japan in 1916, decades before an environmental movement emerged in the West. The experience provoked him to write at length about his annoyance at the way modern man was failing to respect nature. However, Tagore did not simply look for a solution to the problem; he made something creative out of his environmental campaign. He wrote poems, plays, short stories and also a separate group of lyrics in the form of poems for songs under the name of "*Prakriti Parjaay*", emphasizing the need to protect nature as well as our Mother Earth. Tagore not only wrote extensively on man's relationship with the environment but implemented it too by building *Santiniketan.* He created an example for the whole world in terms of the relationship between nature and humans. His love for the natural world got a boost from his sojourns across the lush green nature of East Bengal and amidst the sylvan surroundings of *Santiniketan.* At *santiniketan*, Tagore started the festival of the Earth through *brikkharopan* (planting of trees) in 1927, at which the students would sing and read his poems. This approach gave his environmental campaign a very positive image, so that it was not a negative campaign about what man should not do rather it was a subtle reminder conveyed through creative expression. This encouraged more people to get involved in supporting his campaign.

SECTION – B

There are **FOUR** questions in this Section. Answer **Q. No. 5** and any **TWO** from the rest.

5. Read the following passage and answer the questions that follow: **(45)**

It has been pointed out that learning mathematics and science is not so much learning facts as learning ways of thinking. It has also been emphasized that in order to learn science, people often have to change the way they think in ordinary situations. For example, in order to understand even simple concepts such as heat and temperature, ways of thinking of temperature as a measure of heat must be abandoned and a distinction between 'temperature'

Contd P/3

HUM 135

Contd ... Q. No. 5

and 'heat' must be learned. These changes in ways of thinking are often referred to as conceptual changes. But how do conceptual changes happen? How do young people change their ways of thinking as they develop and as they learn in school? Traditional instruction based on telling students how modern scientists think does not seem to be very successful. Students may learn the definitions, the formula, the terminology, and yet still maintain their previous conceptions. This difficulty has been illustrated many times, for example, when instructed students are interviewed about heat and temperature. It is often identified by teachers as a difficulty in applying the concepts learned in the classroom; students may be able to repeat a formula but fail to use the concept represented by the formula when they explain observed events. The psychologist Piaget suggested an interesting hypothesis relating to the process of cognitive change in children. Cognitive change was expected to result from the pupils' own intellectual activity. When confronted with a result that challenges their thinking- that is, when faced with conflict- pupils realize that they need to think again about their own ways of solving problems, regardless of whether the problem is one in mathematics or in science. He hypothesized that conflict brings about disequilibrium, and then triggers equilibration processes that ultimately produce cognitive change. For this reason, according to Piaget and his colleagues, in order for pupils to progress in their thinking they need to be actively engaged in solving problems that will challenge their current mode of reasoning. However, Piaget also pointed out that young children do not always discard their ideas in the face of contradictory evidence. They may actually discard the evidence and keep their theory. Piaget's hypothesis about how cognitive change occurs was later translated into an educational approach which is now termed 'discovery learning'. Discovery learning initially took what is now considered the 'lone learner' route. The role of the teacher was to select situations that challenged the pupils' reasoning; and the pupils' peers had no real role in this process. However, it was subsequently proposed that interpersonal conflict, especially with peers, might play an important role in promoting cognitive change. This hypothesis, originally advanced by Perret Clermont (1980) and Doise and Mugny (1984), has been investigated in many recent studies of science teaching and learning. Christine Howe and her colleagues, for example, have compared children's progress in understanding several types of science concepts when they are given the opportunity to observe relevant events. In one study, Howe compared the progress of 8 to 12-year-old children in understanding what influences motion down a slope. In order to ascertain the role of conflict in group work, they created two kinds of groups according to a pre-test: one in which the children had dissimilar views, and a second in which the children had similar views. They found support for the idea that children in the groups with dissimilar views progressed more after their training sessions than those who had been placed in groups with similar views. However, they found no evidence to support the idea that the children worked out their new conceptions during their group discussions, because progress was not actually observed in a post-test immediately after the sessions of group work, but rather in a second test given around four weeks after the group work.

Contd P/4

HUM 135

Contd ... Q. No. 5

Questions:

(i) Give an appropriate title with justification.

(ii) Why is acquiring the principles of mathematics and science not so much learning facts as learning ways of thinking?

(iii) How do children learn according to Piaget?

(iv) What is discovery learning?

(v) Describe Howe's experiment with children.

(vi) Give the meanings of the following words:

cognitive, disequilibrium, lone learner, interpersonal, ascertain

6. (a) How does a business letter differ from a personal letter? **(10)**

(b) Write a letter to the Dhanmondi Branch manager of DHL complaining about a damaged parcel that you have recently received. **(10)**

(c) Write phonetic transactions of any **five** of the following words: **(10)**

shame, pleasure, enrich, teach, angle, basic

7. (a) What is plagiarism? Discuss why one should beware of it? **(10)**

(b) Write a composition on any **one** of the following: **(10)**

(i) The power of positive thinking

(ii) Reading Books

(iii) Feeling sad versus feeling lonely

(c) Write a dialogue between a globetrotter and a tour guide in Dhaka. **(10)**

8. (a) Transform any **five** of the following sentences as directed. **(10)**

(i) Nobody will be allowed to enter the hall without a ticket. (Complex)

(ii) Only those boys who work hard, will succeed. (Simple)

(iii) You must avoid fat to lose weight. (Complex)

(iv) It is difficult to explain, but it exists. (Simple)

(v) Do it or you will be punished. (Complex)

(vi) They cried as loudly as possible. (Simple)

(b) What are the components of back matter? Describe in brief. **(5)**

(c) Write short notes on any **three** of the following: **(15)**

(i) Structure of a paragraph (ii) Phonemes (iii) Annual Confidential Report (iv) Sales letter.

L-2/T-1/EEE **Date : 30/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **MATH 259** (Linear Algebra)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols have their usual meaning, Assume reasonable values if any data is missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define orthogonal matrix and unitary matrix with examples. Express the matrix $A=\begin{bmatrix} -2+3i & 1-i & 2+i \\ 3 & 4-5i & 5 \\ 1 & 1+i & -2+2i \end{bmatrix}$ as a sum of hermitian and skew hermitian matrices. **(15)**

(b) Write the LU decomposition of the matrix $A=\begin{bmatrix} 1 & -3 & 0 \\ 0 & 1 & 3 \\ 2 & -10 & 2 \end{bmatrix}$. **(10)**

(c) Define elementary matrix. Express the matrix $A=\begin{bmatrix} 2 & 4 & 7 & 3 \\ 5 & -6 & 8 & 9 \\ 7 & 4 & 3 & 8 \end{bmatrix}$ in the form $B = E_i E_{i-1} \ldots E_2 E_1 A$, where B is the echelon form and E_i's elementary matrices. **(10)**

2. (a) Prove that if A is an invertible matrix, then the system of linear equation $A\underline{x} = \underline{b}$ has a unique solution given by $\underline{x} = A^{-1}\underline{b}$. **(7)**

(b) If $A=\begin{bmatrix} 1 & -1 & 0 & 2 \\ 0 & 1 & 1 & -1 \\ 2 & 1 & 2 & 1 \\ 3 & 2 & 1 & 6 \end{bmatrix}$, find two non-singular matrices P and Q such that $PAQ = I$.

Hence find A^{-1} in terms of P and Q. **(20)**

(c) Find the rank of the matrix $A=\begin{bmatrix} 1^2 & 2^2 & 3^2 & 4^2 \\ 2^2 & 3^2 & 4^2 & 5^2 \\ 3^2 & 4^2 & 5^2 & 6^2 \\ 4^2 & 5^2 & 6^2 & 7^2 \end{bmatrix}$ **(8)**

3. (a) If $\lambda_1, \lambda_2, \ldots, \lambda_n$ are the eigenvalues of A, then prove that $\sum_{i=1}^{n} \lambda_i = tr(A)$ and $\prod_{i=1}^{n} \lambda_i = \det(A)$. **(8)**

(b) Find the eigenvalues and corresponding eigenvectors of the matrix A=$\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$. Is the matrix A diagonalizable? Explain your reasoning. **(12)**

Contd P/2

MATH 259(EEE)

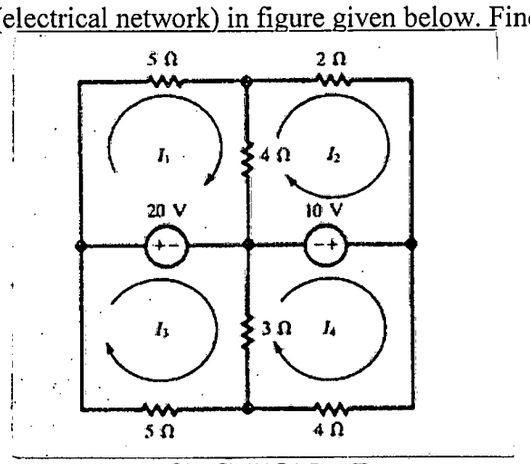
Contd ... Q. No. 3

(c) State Cayley-Hamilton theorem. Verify this theorem for the matrix $A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{bmatrix}$ and hence express A^5 as a linear combination of A^2, A and I. **(15)**

4. (a) Find the minimal polynomial of the matrix $A = \begin{bmatrix} 5 & -1 & 0 \\ -1 & 5 & 0 \\ 0 & 0 & -2 \end{bmatrix}$. **(8)**

(b) Reduce the quadratic form $q = x_1^2 + 2x_2^2 - 3x_3^2 + 8x_1x_2 + 10x_1x_3 - 16x_2x_3$ to the canonical form and find rank, index and signature of the quadratic form. Also, write down the corresponding equations of transformation. **(15)**

(c) There is a circuit (electrical network) in figure given below. Find the unknown currents. **(12)**



SECTION – B

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

5. (a) Derive the standard matrices for the following operations on $\Re^3$:

A rotation of -30^0 about the y-axis, followed by a reflection about the zx-plane, followed by an orthogonal projection on the yz-plane.

Hence find the image of (2, – 2, – 3) with respect to the stated composition of linear operators on $\Re^3$. Also determine whether the matrix operator on $\Re^3$ defined by the composition is one to one. **(18)**

(b) Determine whether the linear operator T: $\Re^3 \rightarrow \Re^3$ defined by the equations

$$\omega_1 = x_1 + 2x_2 + x_3$$
$$\omega_2 = -2x_1 + x_2 + 4x_3$$
$$\omega_3 = 7x_1 + 4x_2 - 5x_3$$

is one to one. If so, find the standard matrix for the inverse operator, and find T^{-1}. **(17)**

6. (a) Consider the basis

$B = \{u_1, u_2\}$ and $B' = \{u_1', u_2'\}$ for $\Re^2$, where $u_1 = (1,0)$, $u_2 = (0,1)$, $u_1' = (1,2)$, $u_2' = (2,1)$

Contd P/3

MATH 259(EEE)

Contd ... Q. No. 6(a)

(i) Find the transition matrix $P_{B' \to B}$ from B' to B.

(ii) Find the transition matrix $P_{B \to B'}$ from B to B'.

Use an appropriate formula to find $[V_B]$ given that $[V'_B] = \begin{bmatrix} 3 \\ -5 \end{bmatrix}$. **(15)**

(b) Let W be the subspace of $\Re^6$ spanned by the vectors **(10)**

$\mathbf{w_1} = (1, 3, -2, 0, 2, 0)$, $\mathbf{w_2} = (2, 6, -5, -2, 4, -3)$,

$\mathbf{w_3} = (0, 0, 5, 10, 0, 15)$, $\mathbf{w_4} = (2, 6, 0, 8, 4, 18)$

Find a basis for the orthogonal complement of W.

(c) Find the eigenvalues and corresponding eigenvectors of the linear transformation T on $\Re^3$ defined by the reflection about the zx-plane. Is the transformation one to one? **(10)**

7. (a) Find a subset of the vectors

$$v_1 = \begin{bmatrix} 1 & -1 \\ 5 & 2 \end{bmatrix}, \; v_2 = \begin{bmatrix} -2 & 3 \\ 1 & 0 \end{bmatrix}, \; v_3 = \begin{bmatrix} 4 & -5 \\ 9 & 4 \end{bmatrix}, \; v_4 = \begin{bmatrix} 0 & 4 \\ 2 & -3 \end{bmatrix}, \; v_5 = \begin{bmatrix} -7 & 18 \\ 2 & -8 \end{bmatrix}$$

that forms a basis for the space spanned by these vectors. Express each vector not in the basis as a linear combination of the basis vectors. Also find their co-ordinate vectors with respect to that basis. **(20)**

(b) Determine whether the following are subspaces of M_{nn}: **(15)**

(i) the set of all n × n matrices A such that $A^T = -A$.

(i) the set of all n × n matrices A such that tr(A) = O.

8. (a) Determine whether the mapping $T: \Re^3 \to \Re^3$ defined by $T(x, y, z) = (x + 2y - z, \; y + z, \; x + y - 2z)$ is a linear operator, if so then find the basis and dimension of (i) Im T and (ii) Ker T. **(15)**

(b) Let $\Re^4$ have the inner product $\langle u, v \rangle = u_1 v_1 + 2u_2 v_2 + 3u_3 v_3 + 4u_4 v_4$. Use Gram-Schmidt process to transform the basis $\{\mathbf{u}_1, \mathbf{u}_2, \mathbf{u}_3, \mathbf{u}_4,\}$ into an orthogonal basis $\{\mathbf{q}_1, \mathbf{q}_2, \mathbf{q}_3, \mathbf{q}_4\}$, where $\mathbf{u}_1 = (0, 2, 1, 0)$, $\mathbf{u}_2 = (1, -1, 0, 0)$, $\mathbf{u}_3 = (1, 2, 0, -1)$, $\mathbf{u}_4 = (1, 0, 0, 1)$. Also, find the angle between the vectors $\mathbf{u}_1$, $\mathbf{u}_2$. **(20)**
