

The figures in the margin indicate full marks.

Symbols bear their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

**SECTION - A**

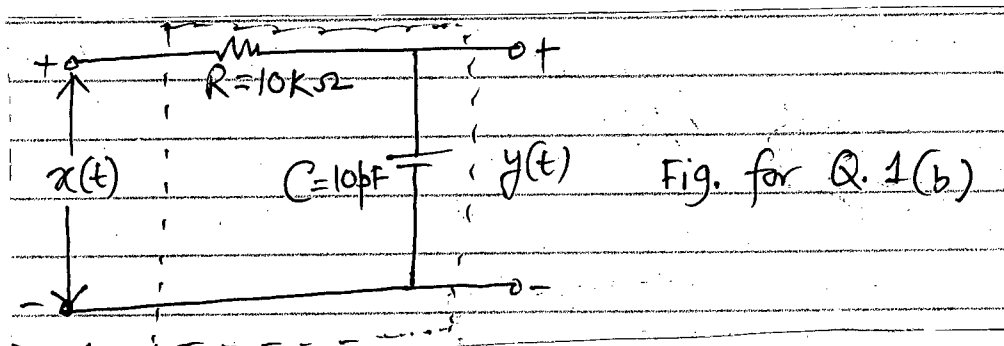
There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) The analytical representation of a square-wave with  $x(t+T) = x(t)$  is given below: (18)

$$x(t) = \begin{cases} 0, & -T/2 < t < -\tau/2 \\ K, & -\tau/2 < t < \tau/2 \\ 0, & \tau/2 < t < T/2 \end{cases}$$

- (i) Draw  $x(t)$  and find the Fourier Series Coefficients  $C_n$  of Fourier Series representation of  $x(t)$
- (ii) Sketch the magnitude spectra of  $x(t)$  for  $\{\tau=1, T=5\}$ ,  $\{\tau=1, T=10\}$  and  $\{\tau=1, T=15\}$ . Comment on the effect of changing T on the frequency spectrum of  $x(t)$ .

- (b) For an input  $x(t) = A \exp[j10^3 t]$  applied to the RC circuit shown in Fig. for Q. 1(b) (17)



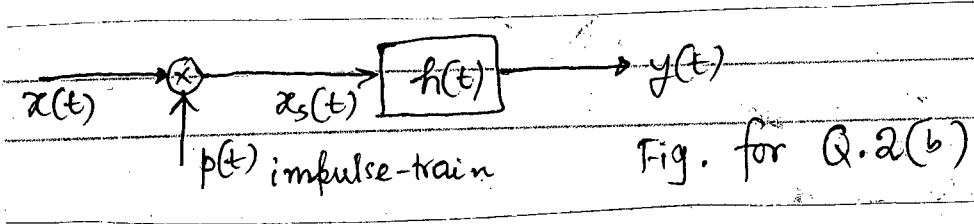
- (i) Find the system function, magnitude and phase functions of the system.
  - (ii) Also, find the response  $y(t)$ .
2. (a) (i) Show that the Fourier Transform of a sequence of impulses in the time domain yields a sequence of impulses in the frequency domain. (4×5=20)
- (ii) Show how the energy of an aperiodic signal can be computed in the Fourier domain.
  - (iii) Show that convolution in the time domain is equivalent to multiplication in the Fourier domain.
  - (iv) If a signal  $x(t)$  is modulated by a cosine signal  $\cos \omega_0 t$ , find the Fourier Transform of the modulated signal  $x(t) \cos \omega_0 t$ .

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**Contd ... Q. No. 2**

(b) Consider the system in Fig. for Q. 2(b).

(15)



where,  $x(t) = \frac{\sin\left(\frac{\omega_B t}{2}\right)}{\pi}$ ,  $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$ .

- (i) Sketch  $X(\omega)$ , the Fourier Transform Spectrum of  $x(t)$   
 $P(\omega)$ , the Fourier Transform Spectrum of  $p(t)$  and  
 find the period of  $p(t)$  from the expression of  $p(\omega)$ .
- (ii) Find and sketch  $X_s(\omega)$ , the Fourier Transform spectrum of the product signal  $x_s(t)$ .
- (iii) The system  $h(t)$  blocks all the undesired components of  $x_s(t)$  in order to obtain  $y(t)$ , which is a scaled version of  $x(t)$ . Write the expressions for  $h(t)$  and  $H(\omega)$ . Sketch  $H(\omega)$ .
- (iv) Also, find and sketch  $Y(\omega)$ .

3. (a)  $Y(s) = L[y(t)]$  be the Laplace Transform of the solution  $y(t)$  of the differential equation,  $y''(t) + 3y'(t) + 2y(t) = 0$ ,  $y(0^-) = 3$ ,  $y'(0^-) = 1$

(12)

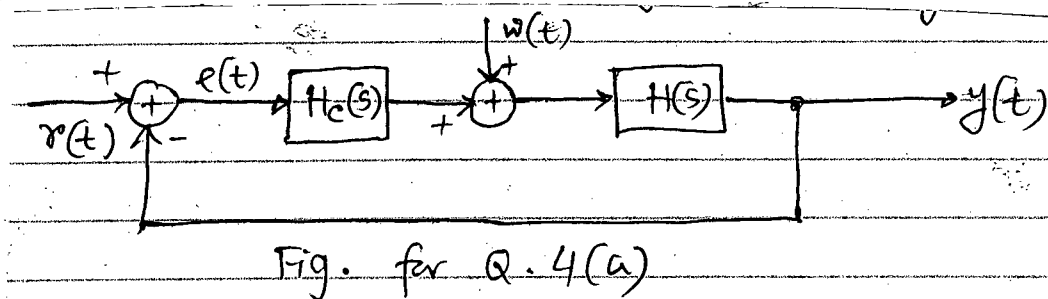
- (i) Find  $Y(s)$
- (ii) For the input  $x(t) = \exp[-3t]u(t)$ , find the transfer function  $H(s)$  of the system.
- (iii) Find the final value of the response  $y(t)$ .

(b) Using inverse Laplace Transform, find the impulse response of the system with transfer function  $H(s) = \frac{s^2 - 3s + 2}{s^3 + 6s^2 + 11s + 6}$ . Draw the two canonical form realizations for this system.

(6+17=23)

4. (a) Consider the block diagram in Fig. for Q. 4(a).

(20)



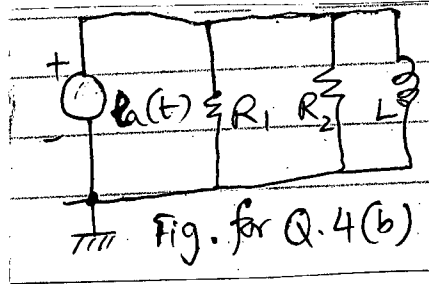
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**Contd ... Q. No. 4(a)**

input  $r(t) = Au(t)$  and the disturbance  $w(t) = Bu(t)$ , where, A and B are constants.

- (i) Find the Laplace Transform  $Y(s)$  of the output  $y(t)$
- (ii) Suppose  $H(s) = \frac{N(s)}{D(s)}$  and  $H_c(s) = \frac{N_c(s)}{D_c(s)}$ .  $H_c(s)$  has to be designed such that  $r(t)$  tracks  $y(t)$ . Find the final value of  $y(t)$  with two necessary assumptions or requirements.

(b) State the D' Alembert's principle. Write the electrical and analogous mechanical differential equations for the electrical circuit shown in Fig. for Q. 4(b) using force-voltage (f-v) analogy. Also, draw the f-v analogous mechanical system for the circuit. (15)



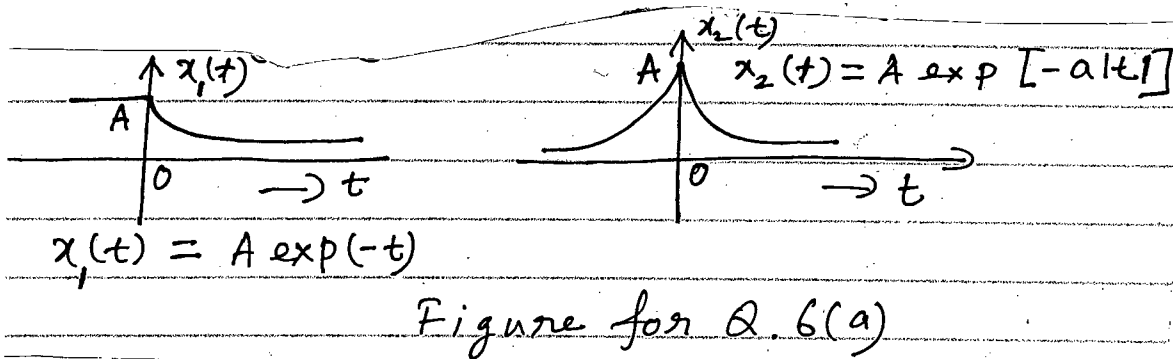
**SECTION - B**

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

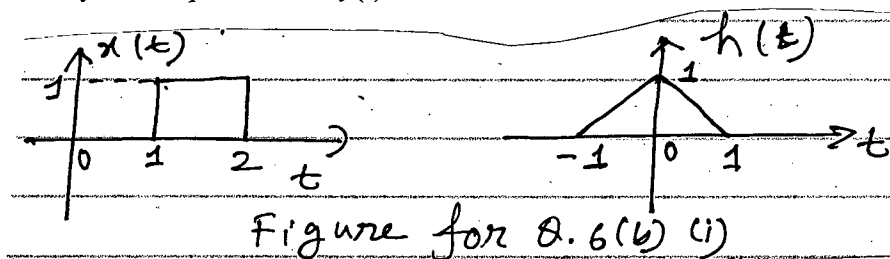
5. (a) (i) Is the signal  $x(t) = \cos\left(\frac{\pi}{3}t\right) + \sin\left(\frac{\pi}{4}t\right)$  periodic? Justify and if periodic, determine the fundamental period of  $x(t)$ . (6+6=12)
- (ii) Consider the signal  $x(t) = A \exp[-\alpha t]; t > 0$  and 0 otherwise. Find and sketch the odd and even parts of the signal.
- (b) (i) Let  $x(t) = u(t+2) - 2u(t+1) + 2u(t) - u(t-2) - 2u(t-3) + 2u(t-4)$ . Sketch  $x(t)$ . Find and sketch  $y(t)$  where  $y(t) = \int_{-\infty}^t x(t) dt$ . (8+15=23)
- (ii) Sketch  $x(t) = -t + 1; -1 \leq t < 0$   
 $= t; 0 \leq t < 2$   
 $= 2; 2 \leq t < 3$   
 $= 0; \text{ otherwise}$
- Sketch  $x(t-2), x(t+3), x(-3t-2), x\left(\frac{2}{3}t + \frac{1}{2}\right)$  and find the analytical expressions for these functions.

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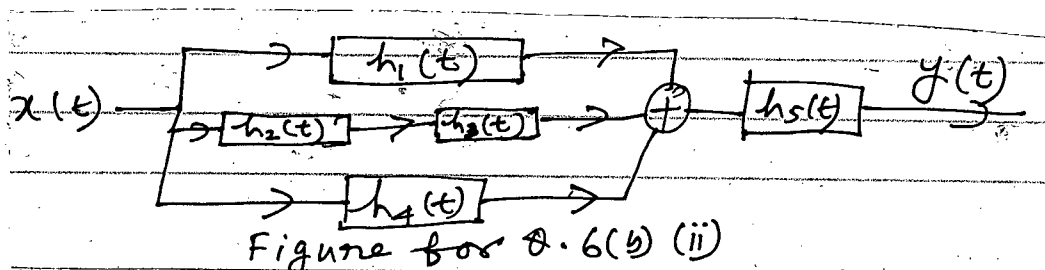
6. (a) Determine whether the following signals are power or energy signals. (10)



(b) (i) The input and impulse response of a linear time invariant (LTI) system are denoted by  $x(t)$  and  $h(t)$ , respectively, and are shown in the following figure. Using the graphical interpretation of convolution, obtain the output of the system,  $y(t)$ . Also, write the analytical expression of  $y(t)$ . (10+15=25)



(ii) Find and sketch the impulse response of the LTI system shown below where  $h_1(t) = \exp[-2t]u(t)$ ,  $h_2(t) = \exp[-2t]u(t)$ ,  $h_3(t) = \exp[-t]u(t)$ ,  $h_4(t) = \delta(t)$  and  $h_5(t) = \exp[-3t]u(t)$ .



Also, determine whether the system is causal and stable.

7. (a) The input-output relationship of a system is given by  $y(t) = Atx(t)$  where  $x(t)$  and  $y(t)$  represent the input and output, respectively. Determine whether the system is linear, time-invariant, causal and stable. (10)

(b) (i) Using state-variable techniques, find the impulse response for the system described by the differential equation:  $y''(t) + 2y'(t) + 2y(t) = x''(t) + 3x'(t) + 3x(t)$  (12+13=25)

(ii) Find the state equations in the first and second canonical forms for the system described by the differential equation:  $y''(t) + 2.5y'(t) + y(t) = x'(t) + x(t)$

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8. (a) The state-space model for an LTI system is given by

**(10+8=18)**

$$v'(t) = \begin{bmatrix} 0 & 1 \\ 2 & -1 \end{bmatrix} v(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} x(t)$$

$$y(t) = [1 \ 0] v(t)$$

(i) By using the Cayley-Hamilton theorem, comment on the stability of the system and determine the state transition matrix.

(ii) For a specified initial-condition vector

$$v_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

find the zero-input response and impulse response of the system.

(b) Consider the system described by the differential equation

**(17)**

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

Find the transformation matrix P to convert the first canonical form into the second.

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## BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2010-2011

Sub : **HUM 279** (Financial and Managerial Accounting)

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) 'In a manual production process, manufacturing overhead depends on direct labor cost'  
– Do you agree? Why or why not? (5)

- (b) Consider the following information relating to XYZ Company for the year ending on  
June 30, 2011: (30)

Purchase of Raw materials	Tk. 80,000
Direct labor	35,000
Utility, Factory	8,000
Rent, Show room	12,000
Free Sample Distribution	7,000
Production Supervisor's Salary	15,000
Income Tax	9,000
Interest	6,000
Depreciation:	
Plant	3,000
Office Building	7,000
Delivery Van	2,000
Power and Fuel	18,000
Sales Commission	4,000
Advertisements	7,000
Indirect labor	3,000
Sales discount	6,000
Raw material, July 01, 2010	8,000
Work-in-process, July 01, 2010	12,000
Finished goods, July 01, 2010	15,000
Raw material, June 30, 2011	13,000
Work-in-process, June 30, 2011	9,000
Finished goods, June 30, 2011	11,000
Sales	350,000

**HUM 279**

**Contd ... Q. No. 1(b)**

Required:

(i) Draw a statement of cost of goods sold and income statement for the year ended on June 30, 2011.

(ii) Compute the quotation price under the following situations:

- Cost of Direct Material is Tk. 30,000 and cost of Direct Labor is Tk. 20,000.
- Manufacturing Overhead is 60% of Direct Labor Cost.
- Regular rate of Admin Overhead is 20% of cost of production, however, it is decided to inflate the rate by 10%.
- Regular rate of Marketing Overhead is 30% of cost of production, however, it is decided to decrease the rate by 10%.
- Manufacturer wants to make a 20% margin on this product.

2. (a) Which principles are related with the adjusting entries? Explain. (5)

(b) 'Advanced Publications' was started on January 01, 2010. The Trial Balance at March 31, 2010 is shown below: (30)

Advanced Publications  
Trial Balance  
March 31, 2010

Account Titles	Debit (Tk.)	Credit (Tk.)
Cash	12,800	
Supplies	2,500	
Prepaid Insurance	3,000	
Office Equipment	5,000	
Notes payable		5,000
Accounts payable		2,500
Unearned Revenue		1,200
Capital		10,000
Drawing	500	
Service Revenue		10,000
Salaries expense	4,000	
Utilities expense	900	
Total	28,700	28,700

**HUM 279**

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

Analysis reveals the following additional data:

- Supplies on hand at March 31, Tk. 1200.
- Insurance policy is for two year.
- Depreciation Tk. 100 for each month.
- Unearned revenue in March 31, Tk. 800.
- Services provided but not recorded Tk. 1200.
- Interest occurred at March 31, Tk. 200.
- Unpaid salary is Tk. 2000

Required:

- (i) Journalize the adjusting entries for the quarter (January-March 2010).
- (ii) Prepare the adjusted trial balance for the quarter (January-March 2010).

3. (a) State the rules for Debit and Credit. (5)

(b) Mr. Ali started his repair shop on February 01, 2011. During the month following events and transactions occurred. (30)

- Feb 1 Made cash investments to start the business Tk. 55,000.
- Feb 3 Paid Tk. 3,600 for one year accidental insurance policy.
- Feb 5 Purchase of furniture for Tk. 8000 - paid Tk. 4500 cash and signed a note for the remaining balance.
- Feb 10 Order to supplier for some repair supplies Tk. 1,000.
- Feb 15 Incurred travel expenses on account Tk. 2,500.
- Feb 17 Received Tk. 12000 in cash from a customer for repair service and billed another customer Tk. 6,000 for services.
- Feb 18 Mr. Ali withdraw cash from his business Tk. 1,500 for personal use.
- Feb 20 Received Tk. 2000 from a customer who was billed on February 17.
- Feb 23 Paid Tk. 2,500 for travel expense incurred on February 15.
- Feb 27 Borrowed Tk. 8,000 from a bank by signing a note.

Required : Show the effect of the transactions on basic accounting equation.

4. (a) Distinguish among Journal, Ledger and Trial Balance. (5)

(b) Miss Shomi started her own consulting firm on April 2010 by investing Tk. 40,000 cash and machineries worth Tk. 30,000. She stated the following events and transactions for first month of operation. (30)



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**Contd ... Q. No. 4(b)**

- April 2     Paid office rent for the month Tk. 5,000.
- April 5     Completed a tax assignment and billed client Tk. 5,000.
- April 6     Purchase supplies Tk. 2,000 on account.
- April 8     Collected 80% of balance due from client billed on April 5.
- April 15    Purchase machinery for Tk. 20,000 and paid 60% in cash.
- April 20    Received Tk. 4,000 advance on a management consulting engagement.

Required:

- (i) Journalize the transactions.
- (ii) Post to the ledger accounts.
- (iii) Prepare trial balance on April 30, 2010.

**SECTION – B**

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

- 5. (a) What are the main limitations of Direct Method of cost allocation? How can simultaneous equation Method solve those limitations? (5)
- (b) Company Z has provided you the following information regarding its two production and two service departments: (20)

Particulars	Production Departments		Service Departments	
	P1	P2	S1	S2
Budgeted overhead costs (Tk.)	500000	700000	300000	200000
Support work finished by:				
S1	40%	50%		10%
S2	50%	30%	20%	

Required:

- (i) Do the allocation under simultaneous equation method.
- (ii) Which of the two service departments get priority at the time of allocation under step down method?
- (c) As per Standard Cost Card, one unit of a product consumes 5 kg of material at a standard price of \$ 7. During a certain period, a total of 4500 kg of material was purchased at \$ 27000. However, 3,400 kg of material was used to produce 700 units.

Required: Compute material variances and give comments.

**(10)**

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6. (a) Compute the payback period of the following project: (8)

	0	1	2	3	4	5
Project X	(200000)	80000	30000	70000	60000	90000

Required:

Should the project be selected if targeted payback period is 3 years or less?

- (b) Consider the same project as stated in (a). If cost of capital is assumed to be 10%, should the project be selected under Net Present Value method? (12)

- (c) Compute the IRR of the same project. Cost of capital is 10%. PVIFA table is given below for use: (15)

	16%	17%	18%	19%	20%
5 years	3.274	3.199	3.127	3.058	2.991

Should the project be selected?

7. (a) What are the different factors that determine the need for working capital of a company? (5)

- (b) Consider the information as given below: (30)

Particulars	Amount (\$)
Purchase (on account)	70,000
Direct Labor	25,000
Depreciation	8,000
Other factory related expenses	12,000
Selling and distribution expenses	15,000
Administrative expenses	10,000
Sales	180,000

Status of inventory level at the beginning and end of the period were as follows:

Types of Inventory	Beginning	Ending
Raw Material	8,000	12,000
Work-in-process	17,000	15,000
Finished Goods	22,000	14,000

In addition, balance of debtors were: beginning - 14000, ending - 26,000 and balance of creditors were: beginning - 12,000, ending - 18,000.

Required:

- (i) Compute Gross Operating Cycle and Net Operating Cycle.  
 (ii) If daily cash requirement is \$ 1200; what will be total working capital need?

**HUM 279**

8. (a) What is a CVP Graph? Can you draw a dummy CVP graph and explain different elements of the graph? **(5)**

(b) Required information for conducting CVP analysis of a company is given below: **(30)**

Particulars	Amount (\$)
Selling Price Per Unit	40
Variable Cost Per Unit	16
Total Fixed Cost	200000

Required:

- (i) Compute CM, CM Ratio, BEP in units and BEP in sales dollar.
  - (ii) Draw an income statement assuming 10,000 units sold. Compute DOL and show the percentage changes in net operating income if sales increases by 10%.
  - (iii) If variable cost increases to 60%, what will be the new selling price per unit to earn the same rate of profit?
  - (iv) Consider original data. An expert may be hired at a fixed cost of \$ 5000 who may save \$ 1 in variable cost. Should the expert be hired?
  - (v) If the company targets to make \$ 80,000 profit, how many units the company have to sell?
-

**SECTION – A**

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

All the symbols and notations used in this part have their usual meanings.

1. (a) Establish the relationship between minterms and maxterms of a truth table. Verify this relation for a 4-variables k-map. (10)
- (b) What is HDL? Briefly mention the salient features of a standard HDL. (5)
- (c) Write verilog code to implement the Boolean function (10)

$$f(x_1, x_2, x_3) = \sum m(2, 4, 6, 7)$$

using the gate level primitives. Ensure that the resulting circuit is as simple as possible. Again write the code using the continuous assignment.
- (d) Derive a CMOS complex gate for the logic function (10)

$$f(x, y, z) = xy + yz + zx$$

Use as few transistor as possible.
2. (a) Draw an NOR-NOR PLA programmed to implement the following functions in NMOS technology – (15)

$$Y_1 = A\bar{B}C + \bar{A}C + B$$

$$Y_2 = \bar{B}AC + AB\bar{C} + \bar{B}$$

$$Y_3 = \bar{A}C + B\bar{C}A$$

$$Y_4 = B + C\bar{B}A + \bar{C}A$$
- (b) Write a verilog code for Q. No. 2(a). (5)
- (c) For  $V_{IH} = 4V$ ,  $V_{OH} = 4.5V$ ,  $V_{IL} = 1V$ ,  $V_{OL} = 0.3V$ , and  $V_{DD} = 5V$ , (15)
  - (i) Calculate the noise margins  $NM_H$  and  $NM_L$  of the binary logic system.
  - (ii) Consider an eight-input NAND gate built using NMOS technology. If the voltage drop across each transistor is 0.1V, what will be the value of  $V_{OL}$ ? Also determine the value of corresponding  $NM_L$  using the other parameters from part (i).

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3. (a) Briefly discuss the triggering techniques of flip-flops/latches. (8)
- (b) Write verilog code that represents a T-flip-flop with an asynchronous clear input. Use behavioral code, rather than structural code. (7)
- (c) Show how a JK flip-flop can be constructed using a T- flip-flop and other logic gates. (10)
- (d) Given a 100 MHz clock signal, derive a circuit using D flip-flop to generate 50 MHz and 25 MHz clock signals. Draw the timing diagram for all three clock signals, assuming negligible delays. (10)
4. (a) A universal shift register can shift in both the left-to-right and right-to-left directions, and it has parallel-load capability. Draw a circuit for such a 4-bit shift register and write the verilog code. (15)
- (b) Design a 3-bit up/down counter T flip-flops. It should include a control input called Up/Down. If  $\overline{\text{Up/Down}} = 0$ , then the circuit should behave as an up-counter. If  $\overline{\text{Up/Down}} = 1$ , then the circuit should behave as a down-counter. (12)
- (c) Write verilog code that represents a modulo-12 up-counter with synchronous reset. (8)

**SECTION – B**

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

5. (a) A Fibonacci series propagates by summing two consecutive numbers starting from 0, 1. Design a Fibonacci number detector considering 4 input bits A, B, C, D and an output bit f. The output should be 1 whenever it detects a number of the Fibonacci series at input. (20)
- (i) Show canonical PoS expression of f.
- (ii) Show the simplest possible PoS expression for f (Use Boolean algebra for simplification).
- (iii) Write the verilog code using the gate level primitives to implement the logic function.
- (b) Now, another system consisting of 4 input bits and one output bit g is used to identify prime numbers. Your task is to combine the Fibonacci detector with the prime number detector in such a way that the combined system has 4 input bits A, B, C, D and two output bits f and g corresponding to Fibonacci number and prime number confirmation flags respectively. Design the minimum cost circuit and compare its cost with the sum of individual costs of two circuits that implement f and g separately. Assume that the input variables are available in both complemented and uncomplemented forms. (15)

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6. (a) Suppose that we want to determine how many of the bits in a 5-bit unsigned number are equal to 1. Design the simplest circuit that can accomplish this task. (15)

(b) In a ternary number system there are three digits 0, 1 and 2. The following table defines a ternary half adder: (20)

A	B	Carry	Sum
0	0	0	0
0	1	0	1
0	2	0	2
1	0	0	1
1	1	0	2
1	2	1	0
2	0	0	2
2	1	1	0
2	2	1	1

Design the circuit that implements this half adder using binary encoded signals, such that two bits are used for each ternary digit. Let  $A = a_1a_0$ ,  $B = b_1b_0$  and  $sum = s_1s_0$ ; Note that the carry is a single bit binary signal. Minimize the cost of the circuit. Use the following encoding

$$(0\ 0)_2 = (0)_3, (0\ 1)_2 = (1)_3, (1\ 0)_2 = (2)_3$$

7. (a) A combinational circuit is defined by the following three functions: (10+8=18)

(i)  $F_1 = \bar{x}\bar{y} + xy\bar{z}$

(ii)  $F_2 = \bar{x}z + y\bar{z}$

(iii)  $F_3 = \prod M(0, 4, 6)$

Design the circuit with only one demultiplexer and some external gates. Also design the circuit using only 4 to 1 multiplexers.

(b) Construct the truth table for a 8 to 3 input priority encoder with input priorities  $\omega_6, \omega_3, \omega_7, \omega_2, \omega_0, \omega_1, \omega_5, \omega_4$  where  $\omega_6$  has the highest priority and  $\omega_4$  has the lowest. The output binaries are denoted as  $y_0, y_1$  and  $y_2$ . Now, design the circuit for the encoder using only 4 to 1 multiplexers. Also write down verilog code for the same operation. (10+7=17)

**EEE 303**

8. (a) Briefly describe how programmable switches are implemented in FPGAs. Also explain how high voltage levels are restored in the switching mechanism of FPGAs. **(10)**
- (b) Consider the function  $f(x_1, x_2, x_3) = \sum m(2, 3, 4, 6, 7)$ . Show a circuit using 5 two input LUTs to implement this expression. Give the truth table implemented in each LUT. **(12)**
- (c) What are the differences between PALs and PLAs? Draw the structure of a macrocell and explain its usage. **(13)**
-

**SECTION - A**

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

All the symbols have their usual meanings.

1. (a) For a transformer, show that  $(Z_{p.u})_{primary} = (Z_{p.u})_{secondary}$ . (10)

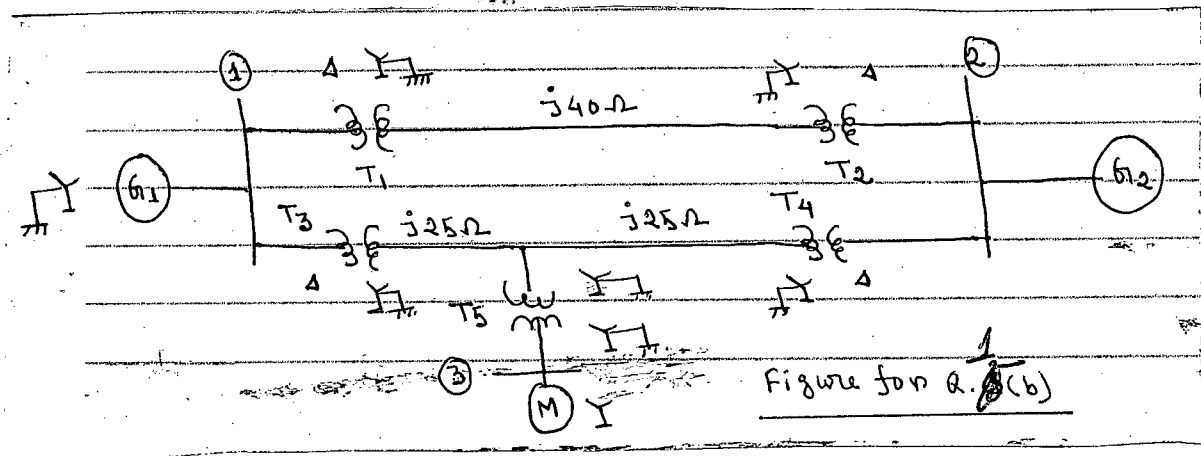
(b) Consider the single line diagram of a power system shown in figure. Equipment ratings are — (25)

$G_1$  : 750 MVA, 18 kV,  $x'' = 0.2$  p.u.,  $G_2$  : 750 MVA, 18 kV,  $x'' = 0.25$  p.u.

M : 1500 MVA, 20 kV,  $x'' = 0.2$  p.u.

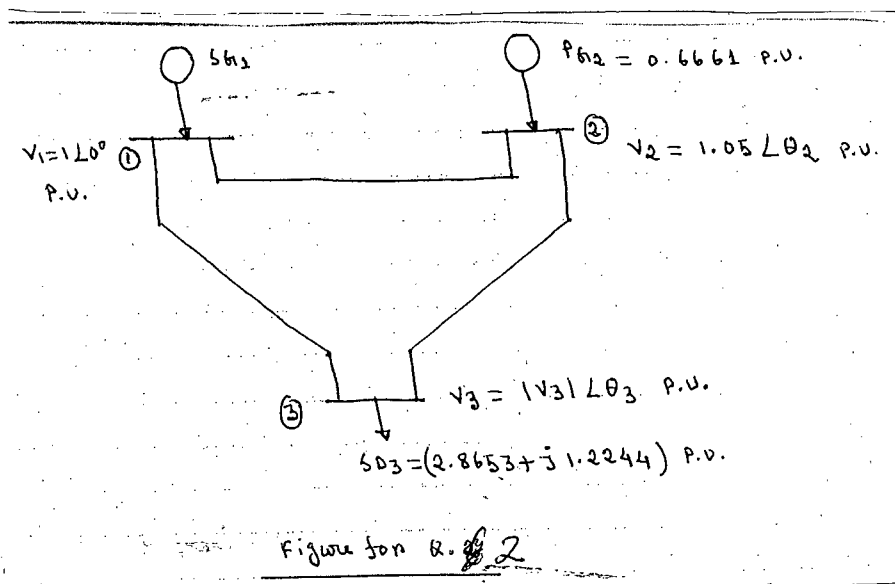
$T_1, T_2, T_3, T_4$  : 750 MVA, 500 kV Y/20 kV  $\Delta$ ,  $x = 0.1$  p.u.

$T_5$  : 1500 MVA, 500 kV Y/20 kV Y,  $x = 0.1$  p.u.



Using a base of 100 MVA and 500 kV for the 40  $\Omega$  line, draw the reactance diagram.

2. For the system shown in Figure below, determine  $\theta_2$ ,  $\theta_3$  and  $|v_3|$  using Newton-Raphson method. Show one iteration only. (35)





**EEE 305**  
**Contd ... Q. No. 2**

In the transmission system all the shunt elements are capacitors with an admittance of  $j 0.01$  p.u. While all the series elements are inductors with an impedance of  $j 0.1$  p.u.

3. (a) For an LL-G fault in phase 'b' and 'c' on an unloaded generator, show that

$$I_{a1} = \frac{E_a}{z_1 + (z_{011}z_2)}. \text{ Also draw the sequence network of the system.} \quad (15)$$

- (b) A Y-connected generator rated at 20 MVA, 13.8 kV has a direct-axis subtransient reactance of 0.25 p.u. The negative and zero-sequence reactances are 0.35 p.u. and 0.10 p.u., respectively. The neutral of the generator is solidly grounded. When a single line-to-ground fault occurs at phase 'a' of the generator operating at unloaded condition, determine —

- (i) Sub-transient fault current in p.u.
- (ii) Line-to-line voltage at sub-transient condition in p.u.

Select a base such that  $E_a = 1 \angle 0^\circ$  p.u.

4. (a) In a 3-phase power system, a double line fault occurs between phase 'b' and 'c'

through an impedance  $z_f$ . If pre-fault voltage is  $v_f$ , show that  $I_{a1} = \frac{v_f}{z_1 + z_2 + z_f}$ . (10)

- (b) A single line-to-ground fault occurs in bus (2) of the power system shown in figure below. The fault is in phase 'a' through an impedance of  $j 0.1$  p.u. Calculate the sub-transient current  $I_{a1}$ . Given that pre-fault voltage,  $v_f = 1.0$  p.u. (15)

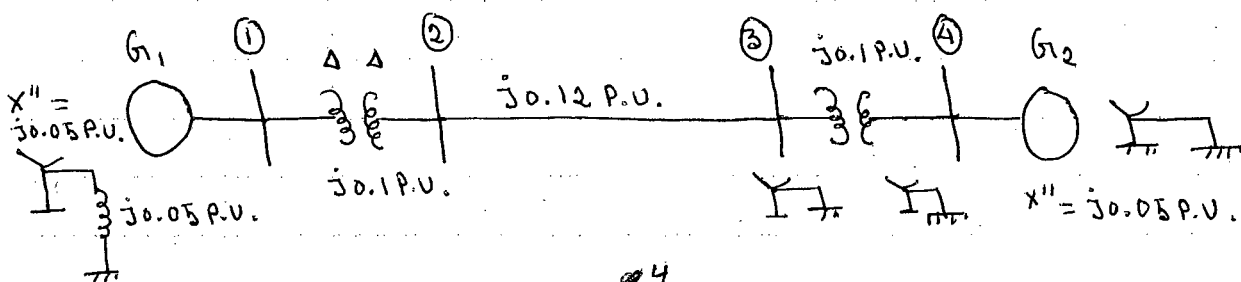


Figure for Q. 4(b)

- (c) Consider a generator with a synchronous reactance of 1.0 p.u., connected to a large system. The bus voltage is  $1 \angle 0^\circ$  p.u. and the generator is supplying a current of 0.8 p.u. at 0.8 p.f. lagging. Now the excitation of the generator is decreased by 15%. Find the reactive power supplied by the generator for this change in field excitation. (10)

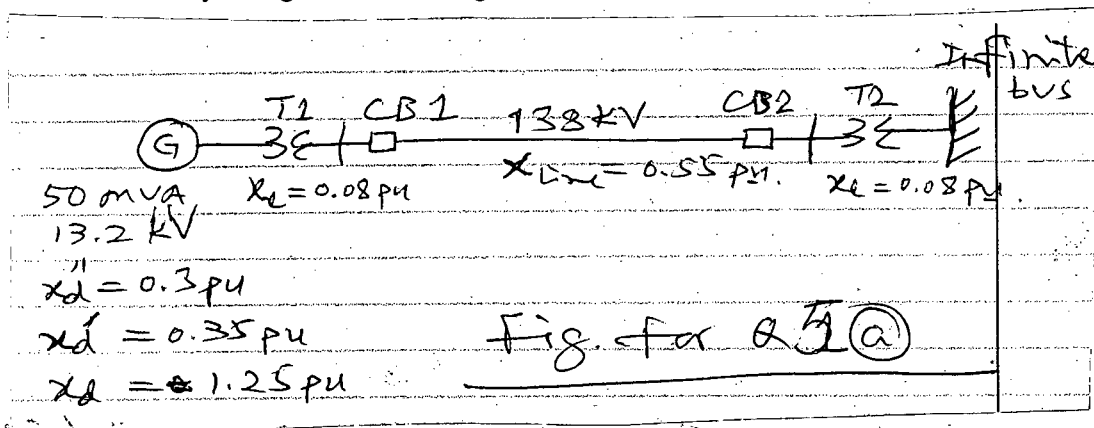
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**SECTION - B**

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

5. (a) Explain the method of symmetrical fault calculation using Z bus. (17)

(b) A synchronous generator is connected to an infinite bus through a 138 kV transmission line as shown in figure. A solid three-phase fault occurs near CB1. Before the fault the receiving-end voltage was 1.0 p.u., 1.0 p.f. and the generator was 75% loaded, on the basis of its MVA rating. Determine the subtransient, transient and synchronous short-circuit currents by using internal voltages of the machine. Ignore d.c. offset current. (18)



6. (a) Develop the sequence circuits of an Y-connected synchronous generator with neutral grounded through a reactor. (15)

(b) The resolution of a set of three-phase unbalanced voltages into symmetrical components gives the following results: (20)

$$V_{a0} = 30 \angle -30^\circ \text{ V}, V_{a1} = 450 \angle 0^\circ \text{ V}$$

$$V_{a2} = 225 \angle 40^\circ \text{ V}$$

The component currents are,

$$I_{a0} = 10 \angle 190^\circ \text{ A}, I_{a1} = 6 \angle 20^\circ \text{ A}, I_{a2} = 5 \angle 50^\circ \text{ A}$$

Determine the complex 3 $\phi$  power by

(a) Symmetrical component

(b) Unbalanced phase components.

7. (a) Interpret the equations that describe a long transmission line (8)

(b) Derive equations for power flow through a transmission line in terms of ABCD constants. Using these equations discuss aspects of power transmission through transmission line. (12)

(c) A 3-phase 50 Hz transmission line is 400 km long. The voltage at the sending-end is 220 kV. The line parameters are (15)

$$r = 0.125 \ \Omega/\text{km}$$

$$x = 0.4 \ \Omega/\text{km}$$

$$y = 2.8 \times 10^{-6} \text{ mho}/\text{km}$$

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Find: (i) sending-end current and receiving-end voltage when there is no load on the line.

(ii) The maximum permissible line length if the receiving-end no-load voltage is not to exceed 235 kV.

8. (a) With simple example and assumed data explain the terms demand factor, group diversity factor, peak diversity factor, load factor, capacity factor and utilization factor. **(10)**
- (b) What is transient recovery voltage (TRV)? Comment on the origin of TRV. **(7)**
- (c) Derive an expression for restriking voltage. **(8)**
- (d) Explain, how the principle of high resistance arc extinction is practically implemented. **(10)**
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