L-3/T-1/EEE **Date: 01/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **EEE 309** (Communication Systems 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**.

Answer in brief and to the point. Make reasonable assumptions on any missing information.

1. (a) Briefly explain how modulation is useful for the (i) efficient utilization of channel bandwidth, and (ii) feasible antenna length. **(10)**

(b) The message $m(t)$ and the carrier $c(t)$ of an DSB+C AM communication system are,

$m(t)=16\cos(20\pi\times10^3t)+12\cos(40\pi\times10^3t)+8\cos(60\pi\times10^3t)$

$c(t)=20\cos(4\pi\times10^6t)$

(i) Derive the frequency domain expression of the AM signal.

(ii) Draw the amplitude spectrum of the AM signal.

(iii) Calculate the total transmitted power and power efficiency of the system.

(iv) If $m(t)=6\cos(10\pi\times10^3t)+8\sin(10\pi\times10^3t)$ and $c(t)$ is as above, determine whether envelope detection can be used or not. (18)

(c) With necessary diagram, derive the expression of the signal at the output of a synchronous detector for DSB+C AM when the transmitter and receiver carriers are out of phase by an angle of θ. **(7)**

2. (a) With necessary diagram, explain one of the feasible methods for countering noise in a long distance digital communication system. **(9)**

(b) A section of a communication system is show in Fig. for Q. No. 2(b). If the input signal $m(t)$ has a power $P_{in}=46$ dBm, calculate-

(i) noise figure of the Amplifier 1, (ii) noise figure of the transmission line, (iii) noise added by the Amplifier 2, and (iv) noise temperature of the total system. (14)

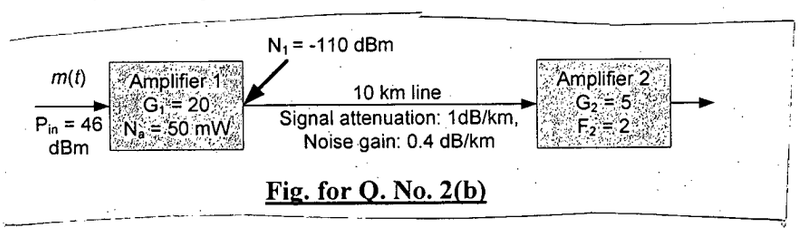

Fig. for Q. No. 2(b)

(c) Now take $m(t)=8\cos(4000\pi t)+6\cos(8000\pi t)$ V as the input signal for the system shown in Fig. for Q. No. 2(b). Also consider a phase constant $\beta=10^{-2}\omega$ radian for the total system and ignore noise. **(12)**

(i) Determine whether the received signal will be distorted. Justify your answer.

(ii) Derive the expression of the received signal.

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3. (a) Compare the contrast optical fiber and wireless channel as communication media. **(10)**

(b) For the message signal $m(t)$ as shown in Fig. for Q. No. 3(b) and carrier $c(t) = 4\cos(4000\pi t)$, (i) derive the expression of the PM signal, and (ii) draw the PM signal by showing the frequencies and the phase shifts. Assume, $k_p = \pi/3$ radian/volt. **(12)**

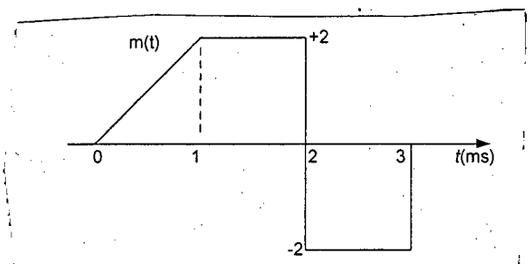

Fig. for Q. No. 3(b)

(c) Consider an FM system with a single-tone message with amplitude $A_m = 2$ V and frequency f_m = 20 kHz. The carrier has an amplitude A_c = 2 V and frequency f_c = 1 GHz. The carrier component in the FM signal has 20% of the total transmitted power. **(13)**

Using the attached Bessel function plot as shown in Fig. for Q. No. 3(c),

(i) calculate modulation index

(ii) draw the FM amplitude spectrum showing both amplitude and frequencies

(iii) calculate the bandwidth using the 1% rule

(iv) calculate the total transmitted power contained in the signals of frequencies above the carrier frequency.

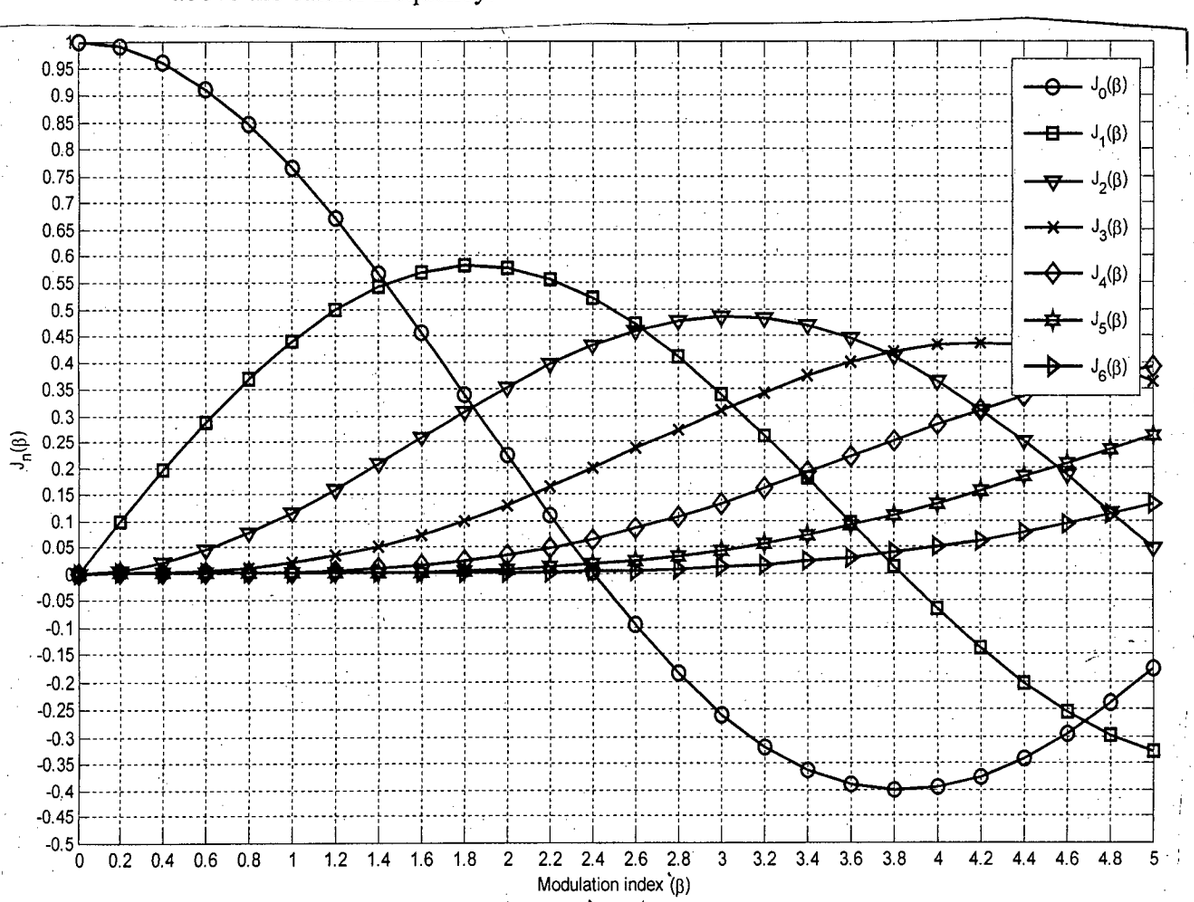

Fig. for Q. No. 3(c)

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4. (a) Draw a ring modulator used to generate DSB-SC AM signal. Then, draw the amplitude spectrum of the signals at the input and the output of the BPF in a ring modulator assuming message signal $m(t)=\cos(8000\pi t)$, carrier $c(t)=8\cos(2\pi\times10^6 t)$ and the center frequency of the BPF is twice that of the carrier frequency. **(12)**

(b) Explain why demodulation of SSB+C signal using envelope detector is not preferred. **(11)**

(c) Draw a detailed block diagram of the Weaver method used for generating SSB signal. Explain why this method is preferred. **(12)**

SECTION – B

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

5. (a) Draw the block diagrams of transmitter and receiver for a DPCM system and show that reconstruction error is equal to the quantization error. **(15)**

(b) The message signal, $m(t)=10\cos(8000\pi t)$ is sampled at 700% higher than the Nyquist rate and passed through a DPCM modulator. DPCM modulator uses a transversal filter of two delay units as a linear predictor with weights $W_1 = 2$ and $W_2 = -1$ and a 3 bit mid-rise uniform quantizer. The peak value of the difference between the sampled value and the predicted value is 4 V and the signal obtained by the differences can be approximated as sinusoidal. Both the previous two values to the input of the predictor are 8.5 V, i.e., $m_q(-T_s)=m_q(-2T_s)=8.5\,\text{V}$ and the first sample start at t = 0. Determine- **(20)**

(i) the reconstruction errors and the data bit sequence for the first 4 samples and

(ii) the SQNR and the data rate of the DPCM system.

6. (a) The message signal shown in Fig. for Q 6(a) is sampled at 6 kHz starting from t = 0 for Δ-modulation. Determine- **(17)**

(i) the step size such that the slope overloading noise is the minimum,

(ii) the data rate, and

(iii) the data rate if PCM is used instead of Δ-modulation and SQNR higher than 18 dB is achieved with the same sampling frequency by changing step size.

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

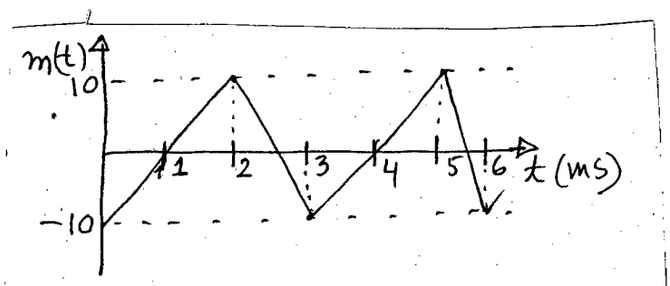

Fig. for Q.6(a)

(b) The amplitude spectrum of a message signal, $m(t)$ is given as, $M(f)=4rect\left(\frac{f}{2B}\right)$, where B is the bandwidth and B = 4 kHz. To obtain a PAM signal, the messae signal is sampled at 25% higher than the Nyquist rate and passed through a flat-top filter having impulse response, $h(t)=\Pi\left(\frac{t}{\tau}\right)$, where τ = 0.025 ms. Draw the amplitude spectrum of PAM signal. What is the bandwidth of the PAM signal? Draw a block diagram to reconstruct the message signal from the PAM signal mentioning the values of the parameters in the different parts of the block diagram. State the advantage(s) and disadvantage(s) of decreasing the value of τ in PAM system. **(18)**

7. (a) Draw the block diagrams of BFSK modulator and demodulator with coherent detection. Then draw the output signals at the outputs of each part of the block diagrams for a digital bit sequence "10" assuming f_0 = 10 kHz and f_1 = 25 kHz, and data rate = 5 kbps. Also draw the amplitude spectrum of BFSK signal and then determine the bandwidth of the BFSK transmission. **(17)**

(b) Design QPSK modulator and demodulator for the constellation diagram shown in Fig. for Q. 7(b) with necessary calculations and justifications. Also draw the typical QPSK signal for a data sequence "10010011" according to your design. **(18)**

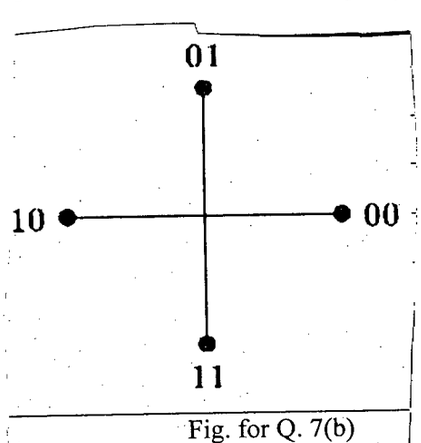

Fig. for Q. 7(b)

Contd P/5

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8. (a) Write down the advantages and disadvantages of a TDM system. Describe a T-1 line and show that the data rate of a T-1 line is 1.544 Mbps. **(11)**

(b) Suppose, you are appointed as an Assistant Engineer in PABX office of BUET. You are requested to design a telephone system with E-carrier. Currently, the number of required telephone connection at BUET is 800. The number of telephone connection increment per year is estimated as 50. Assuming the lifetime of the telephone equipment to be 15 years, design the telephone system. **(12)**

(c) The PN sequences of User-1, User-2 and User-3 for a 3-user DS-CDMA system are C1=[1,-1,1,-1], C2=[1,1,-1,-1], and C3=[1,1,1,1], respectively. In a bit period, User-1, User-2 and User-3 are transmitting data bits 1, 0 and 1, respectively. Draw the baseband signal received by a receiver from the channel (i) if the channel is free from noise and interference and (ii) DC magnitude of 0.5 V is added in the channel as interference. Also determine the detected bit by the User-2 for the case (i) and (ii), and comment on the results. **(12)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub : **EEE 311** (Digital Signal Processing 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) Determine the unit step response of a system with difference equation **(15)**

$$y[n]-\frac{3}{4}y[n-1]+\frac{1}{8}y[n-2]=x[n]+2x[n-1]$$

$$y[-1]=4,\ y[-2]=0$$

(b) Consider a system that satisfies the difference equation **(10)**

$$y[n]=ny[n-1]+x[n].$$

The system is causal and satisfies initial rest conditions, i.e., if x[n] = 0 for $n < n_0$, then y[n] = 0 for $n < n_0$.

(i) If x [n] = δ[n], determine y [n] for all n.

(ii) Is the system linear and time-invariant (LTI)? Justify.

(c) Find y [n] = x [n] * w[n], Consider v[n] as unit step function and $h_1[n] = \delta[n-1]$ and $h_2[n] = \delta[n-2]$. **(10)**

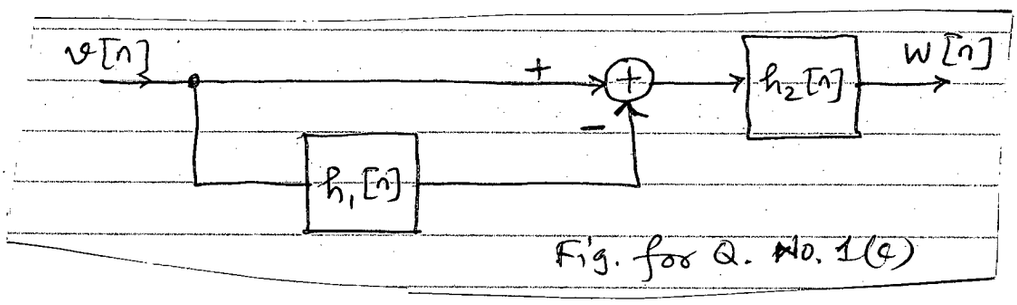

Fig. for Q. No. 1(a)

2. (a) Given that **(15)**

$$H_{lp}\left(e^{jw}\right)=\begin{cases}1, & |w|<0.2\pi\\ 0, & 0.2\pi\le|w|\le\pi\end{cases}$$

(i) If $h_1[n] = (-1)^n h_{lp}[n]$, find and sketch $H_1\left(e^{jw}\right)$ for $|w| < \pi$.

(ii) If $h_2[n] = 2h_{lp}[n]\cos(0.5\pi n)$, find and sketch $H_2\left(e^{jw}\right)$ for $|\omega| < \pi$.

(b) Consider the system given in Q. No. 2(a). **(5)**

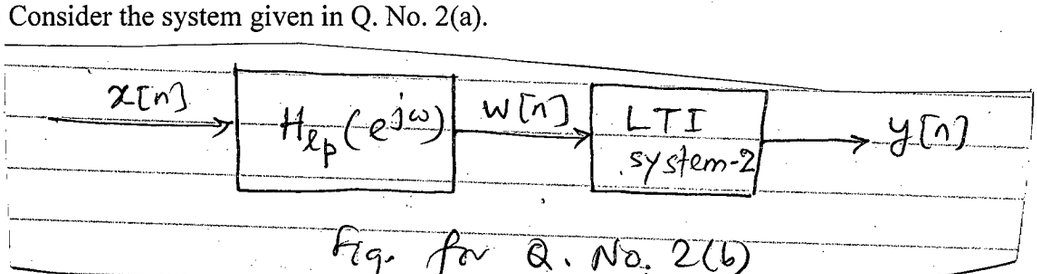

Fig. for Q. No. 2(b)

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

The LTI System-2 in the fig. for Q. No. 2(b) is described by y[n] = w[n] - w[n-1]

and $H_{lp}\left(e^{jw}\right)=\begin{cases}1, & |w|\le 0.2\pi \\ 0, & 0.2\pi \le w \le \pi\end{cases}$

Find y(n), for the input

x(n) = cos (0.3πn) + 3δ[n-3] + 3.

(c) Write the major differences between discrete time Fourier series (DTFS) and discrete-time Fourier transform (DTFT). **(5)**

3. (a) When the input to a causal LTI system is **(18)**

$$x[n]=-\frac{1}{3}\left(\frac{1}{2}\right)^n u[n]-\frac{4}{3}2^n u[-n-1],$$

The z-transform of the output is

$$Y(z)=\frac{1+z^{-1}}{\left(1-z^{-1}\right)\left(1+\frac{1}{2}z^{-1}\right)\left(1-2z^{-1}\right)}.$$

(i) Find the region of convergences of X(z), Y(z) and H(z).

(ii) Find the impulse response h[n] and comment on the stability of the system.

(b) If the input x[n] to an LTI system is x[n]=u[n], the output is $y[n]=\left(\frac{1}{2}\right)^{n-1}u[n+1]$. **(17)**

(i) Find the system transfer function H(z) and impulse response h[n].

(ii) Comment on stability and causality of the system.

4. (a) For the following system function H(z) find the minimum phase system $H_{min}(z)$ such that $\left|H\left(e^{jw}\right)\right|=\left|H_{min}\left(e^{jw}\right)\right|$ **(12)**

$$H(z)=\frac{\left(1+3z^{-1}\right)\left(1-\frac{1}{2}z^{-1}\right)}{z^{-1}\left(1+\frac{1}{3}z^{-1}\right)}$$

(b) The system function H(z) of a causal LTI system has the pole-zero configuration shown below. **(15)**

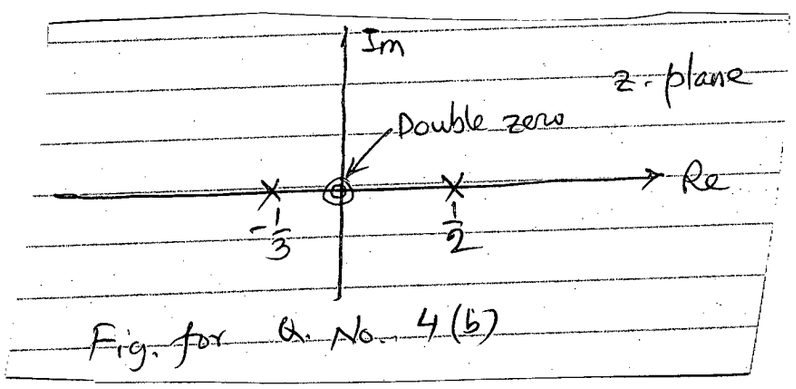

Fig. for Q. No. 4(b)

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

It is known that H(z) = 6 when z = 1.

(i) Find H(z) and the impulse response h[n].

(ii) Find the response of the system for an input x[n] which is obtained from x(t) = 50 + 10 cos 20πt + 30 cost 40πt. Consider sampling frequency F_s = 40 samples/sec.

(c) x[n] is obtained from $x_c(t)$ using Nyquist sampling rate and $x_d[n]$ is obtained by down sampling x[n] with a factor M = 3. Sketch $X(e^{jw})$ and $X_d(e^{jw})$. **(8)**

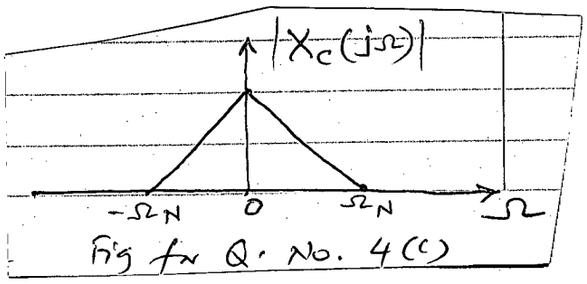

Fig for Q. No. 4(c)

SECTION – B

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

5. (a) Consider the real finite-length sequence x[n] in Fig. Q5(a). **(20)**

(i) Sketch the finite-length sequence y[n] whose six-point DFT is, $Y[k]=W_6^{4k}\times[k]$, where X[k] is a six-point DFT of x[n]

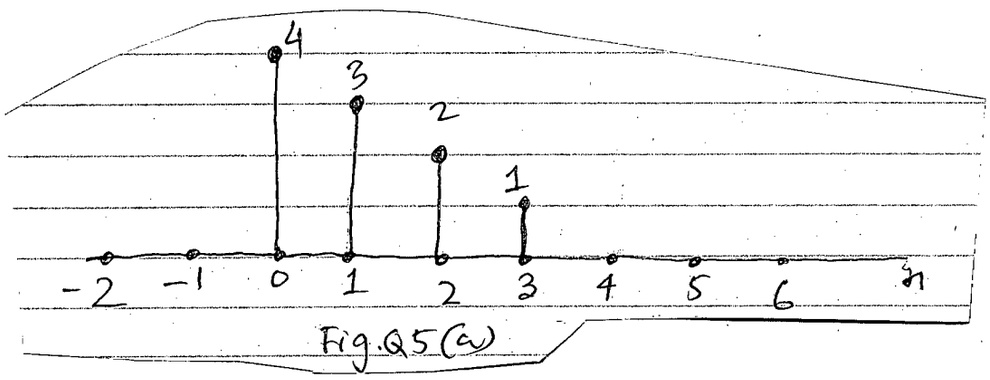

Fig.Q5(a)

(ii) Sketch the finite-length sequence z[n] whose six point DFT is $Z(k)=Re[X[k]]$

(iii) Sketch the finite-length sequence q[n] whose 3-point DFT is Q[k] = X[2k], k=0, 1, 2

(b) The sequences $x_1[n]$ and $x_2[n]$ are given as follows,

$x_1[n] = \{4\ \underset{\uparrow}{0}\ 1\ 2\}$, $x_2[n] = \{1\ 2\ \underset{\uparrow}{0}\ 3\}$

(i) Find $\hat{y}[n]$ which is four point circular convolution between $x_1[n]$ and $x_2[n]$, $0 \le n \le 3$

(ii) Find $X_1[k]$ and $X_2[k]$ in terms of W_N^{kn}, where W_N^{kn} = exp (-j2πkn/N)

(iii) Calculate y[n] from $X_1[k]$ and $X_2[k]$ using the inverse DFT.

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6. (a) (i) Draw the signal flow graph for the transposed direct form II implementation of the **(20)**

LTI system with system function $H(z)=\dfrac{1-\frac{7}{6}z^{-1}+\frac{1}{6}z^{-2}}{1+z^{-1}+\frac{1}{2}z^{-2}}$

(ii) Consider the signal flow graph in Fig. Q6(a)(ii)

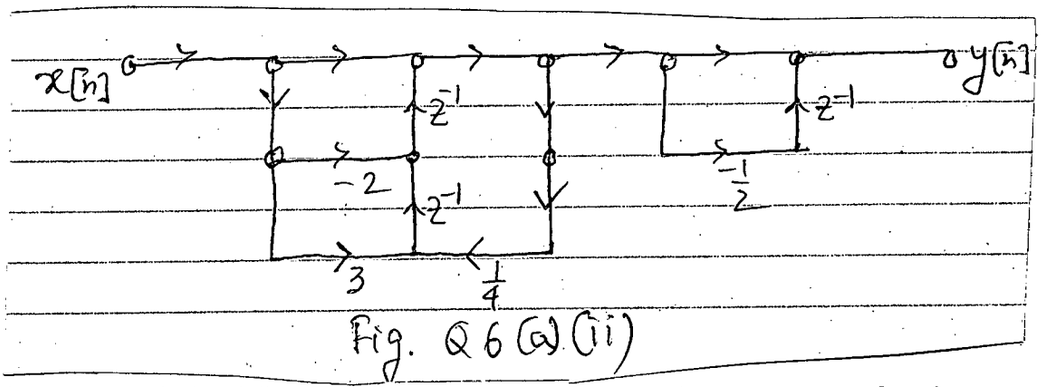

Fig. Q6(a)(ii)

Draw the transposed signal flow graph and confirm that it has the same system function H(z) as the original system in Fig Q6(a) (ii).

(b) The impulse response of a linear time invariant system is, $h[n]=\begin{cases}a^n, & 0\le n\le 7\\ 0, & otherwise\end{cases}$ **(15)**

(i) Draw the flow graph of a direct-form non recursive implementation of the system.

(ii) Show that the corresponding system function can be expressed as, $H(z)=\dfrac{1-a^8z^{-8}}{1-az^{-1}}$, $|z|<|a|$

7. (a) Using Kaiser window method, a discrete-time filter with generalized linear phase has to be designed that meets specifications of the following form: **(20)**

$\left|H\left(e^{jw}\right)\right|\le 0.01, \quad 0\le|w|\le 0.25\pi$

$0.95\le\left|H\left(e^{w}\right)\right|\le 1.05, \quad 0.35\pi\le|w|\le 0.6\pi$

$\left|H\left(e^{jw}\right)\right|\le 0.01, \quad 0.65\pi\le|w|\le\pi$

(i) Determine the minimum length of the impulse response and value of the Kaiser window parameter β for a filter that meets the preceding specifications.

(ii) What is the delay of the filter?

(iii) Determine the ideal impulse response hd[n] to which he Kaiser window should be applied.

(iv) Explain why Hamming window is preferred over rectangular window for FIR filter design. Mention how to overcome the two main problems of implementing an ideal FIR LPF. **(15)**

8. (a) A discrete-time low-pass filter is to be designed by applying the impulse invariance method to a continuous-time Butterworth filter having magnitude squared function **(25)**

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$$|Hc(j\Omega)|^2 = \frac{1}{1+\left(\frac{\Omega}{\Omega_c}\right)^{2N}}$$

The specifications for the discrete-time system are

$$0.89125 \le \left|H\left(e^{jw}\right)\right| \le 1 \ , \ 0 \le |w| \le 0.2\pi$$

$$\left|H\left(e^{jw}\right)\right| \le 0.17783, \quad 0.3\pi \le |w| \le \pi$$

Design the continuous time Butterworth filter to meet passband and stopband specifications as determined by the desired discrete-time filter.

(b) In Bilinear transform method of IIR filter design, show that a causal stable continuous time filter maps into a causal stable discrete time filter. **(10)**

L-3/T-1/EEE **Date: 17/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

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) Define with example- Matching principles and Full disclosure principles. **(6)**

(b) "T Automobile Agency" was opened at May 1, 2018. The following transactions occured in the month of May- **(29)**

May 1: Mr. T invested Tk. 300,000 cash in the business.

May 2: Hired an office executive at a monthly salary of Tk. 12,000.

May 5: Paid advertising expense for the month in cash Tk. 4,000.

May 8: Received utility for the month Tk. 6,000 but payment will be made on next month.

May 11: Purchased office equipment for Tk. 20,000; Paid Tk. 15,000 in cash and the remaining amount will be paid in a later date.

May 14: Received Tk. 20,000 cash from the customers by providing services.

May 15: Paid to accounts payable Tk. 5,000 in cash.

May 23: Received Tk. 35,000 from a customer in advance, service to be performed in next month.

May 26: Withdrew Tk. 5,000 cash from the business for personal use.

May 28: Borrowed Tk. 55,000 in cash from a bank by signing notes payable.

Required:

(i) Show the effects of the above transactions on the accounting equation for the month of May, 2018.

(ii) Also prepare an owners' equity statement for the month.

2. (a) Mr. Kim started a business. During January 2016, the following transactions occurred: **(16)**

January 1: Service provided to a customer but not yet received Tk. 50,000.

January 3: Purchase machinery on account Tk. 60,000.

January 7: Earned revenue Tk. 45,000 of which Tk. 10,000 is collected in cash and the balance was due in January.

January 9: Incurred interest expenses for the month on account Tk. 7,000.

January 11: Made an investment by Mr. Kim for Tk. 100,000 in cash, related to transaction of date 7.

January 13: Received Tk. 10,000 in cash from the customer by providing services.

January 15: Paid salary for the month Tk. 9,000 in cash.

January 17: Paid Tk. 15,000 to account payable for machinery.

Required:

(i) Journalize the above transactions.

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Contd... Q. No. 2

(b) Following information is available for "Seashell Company"- **(19)**

Seashell Company

Income Statement

For the year ended December 31, 2016

	Amount (Tk.)
Net sales	**900,000**
Less: Sales returns and allowances	80,000
Net sales	**820,000**
Less: Cost of goods sold	300,000
Gross profit	**520,000**
Less: Operating expenses	100,000
	420,000

Seashell Company

Balance Sheet

December 31, 2016

Asset	**Amount (Tk.)**	**Liabilities and Equity**	**Amount (Tk.)**
Cash	35,000	Accounts payable	60,000
Accounts receivable	50,000	Other current liability	25,000
Inventory	90,000	Long term debt	80,000
Investments	75,000	Common stock (Tk. 10 par)	340,000
Plant asset (net)	400,000	Retained earnings	145,000
Total asset	**650,000**	**Total Liabilities and Equity**	**650,000**

Other information: Common stock recently sold in market at Tk. 8.00 per share.

Required:

(i) Profit margin.

(ii) Asset turnover or Return on asset.

(iii) Return on equity (ROE).

(iv) Quick or acid test ratio.

(v) Earnings per share (EPS).

(vi) Price earnings ratio.

(vii) Debt to total assets.

(viii) Inventory turnover.

(ix) Accounts receivable turnover.

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3. (a) Write down the types of accruals under adjusting entries and identify the types of adjustments applicable to each category. **(5)**

(b) The Trial Balance of "Eco Electronics" at June 30, 2015 is given below- **(30)**

Eco Electronics

Trial Balance

June 30, 2015

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	26,500	
Supplies	2,500	
Prepaid insurance	30,000	
Office equipment	10,000	
Notes payable		50,000
Furniture	20,000	
Accounts payable		1,000
Unearned revenue		12,000
Capital		21,000
Drawings	500	
Service revenue		12,500
Salary expense	5,000	
Utility expense	1,000	
Interest expense	1,000	
Total	**96,500**	**96,500**

Other Information:

- Insurance policy is for 5 years.
- One third of the unearned revenue is earned at the end of the period.
- Supplies on hand at June 30, 2015 Tk. 1,200.
- Service provided to the customers but not recorded amount Tk. 5,000.
- Depreciation on office equipment is Tk. 500 per month
- Interest accrued at June 30, Tk. 2,500.
- Salary accrued at June 30, Tk. 1,500.

Required:

(i) Prepare necessary adjusting entries.

(ii) Prepare an adjusted trial balance as at June 30, 2015.

Contd P/4

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4. (a) Why is it possible to prepare financial statements directly from an adjusted trial balance? **(5)**

(b) The following accounts are taken from the ledger balances of "Hatil Furniture's Ltd" at 31st December, 2014: **(30)**

"Hatil Furniture's Ltd"

Trial Balance

31st December 2014

Accounts Title	Debit (Tk.)	Credit (Tk.)
Cash	50,000	
Equipment	35,000	
Accounts receivable	20,000	
Accounts payable		10,000
Capital		50,000
Supplies	1,200	
Trademark	25,000	
Tax payable		18,200
Salary expense	9,000	
Sales salary expense	3,000	
Notes payable		12,000
Store machinery	30,000	
Unearned revenue		20,000
Sales		150,000
Cost of goods sold (COGS)	50,000	
Prepaid insurance	4,000	
Rent expense	25,000	
Utility expense	8,000	
Drawings	2,000	
Long term investment	18,000	
Noncurrent liability		20,000
Total	**280,200**	**280,200**

Adjustments data:

(i) Depreciation is @10% on store machinery.

(ii) 50% of rent expense is related to office and remaining to sales.

Required:

(i) Prepare a multiple step (classified) income statement for the year ended December, 2014.

(ii) Prepare an owners' equity statement and a classified balance sheet at 31st December, 2014.

Contd P/5

Contd P/6

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Contd... Q. No. 5

(vi) Refer to the original data. The company is considering eliminating sales commissions entirely in its stores and increasing fixed salaries by $107,000 annually.

a. If this change is made, what will be the new break-even point in dollar sales and in unit sales in **Store 36**?

b. Would you recommend that the change be made? Explain.

6. Xansi Corporation produces and sells a single product, Smart Watch. Selected cost and operating data relating to the product for two years (2016 & 2017) are given below: **(35)**

Selling price per Unit	$100
Manufacturing costs:	
Variable per unit produced:	
Direct materials	$32
Direct labor	$8
Variable manufacturing overhead	$6
Fixed Manufacturing Overhead Cost per year	$300,000
Selling and Administrative Expenses:	
Variable per unit sold	$6
Fixed per year	$80,000

Particulars	**Year**	
	2016	**2017**
Finished Goods Inventory (in Units on 1st January)	0	2000
Units Produced during the year	10000	5000
Units Sold during the year	8000	6000
Finished Goods Inventory (in Units on 31st December)	2000	1000

Required:

(i) **Assume the company uses Absorption Costing.**

a. Compute the unit product cost in each year.

b. Prepare an income statement for each year.

(ii) **Assume the company uses Variable Costing.**

a. Compute the unit product cost in each year.

b. Prepare an income statement for each year.

(iii) **Why there is difference in income between two methods?**

(Reconcile the variable costing and absorption costing net operating incomes.)

Contd P/7

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7. (a) Define the following terms: (i) cost behavior and (ii) relevant range. **(5)**

(b) The following data from the just completed year ended 31st December 2017, are taken from the accounting records of Gravy Company Ltd: **(30)**

Sales	Tk. 750,000
Sales Return	50,000
Direct Labor Cost	90,000
Indirect Labor Cost	5,500
Office Rent Expense	10,000
Raw material purchases	132,000
Purchase Return	2,000
Sales Commission	66,000
Advertising Expense	5,000
Administrative Expenses	43,000
Depreciation Expense (Factory Machine)	11,000
Depreciation Expense (Office Furniture)	11,000
Insurance Expense (Office)	8,000
Other manufacturing overhead costs	220,000

Inventory related information are as follow.

Inventories	Beginning of Year	End of Year
Raw Materials	Tk. 8,000	Tk. 10,000
Work in process	Tk. 5,000	Tk. 20,000
Finished Goods	Tk. 70,000	Tk. 25,000

Requirements:

(i) Prepare a schedule of Cost of Goods Sold.

(ii) Prepare an Income Statement for the year ended on 31st December 2017.

8. (a) Jamuna Ltd. has three production departments (Cake, Biscuit and Bread) and two service departments (Maintenance and Cleaning). The overheads for the departments before reallocation are given below: **(13)**

Department	Overheads
Cake (CK)	Tk. 45,000
Biscuit (BC)	Tk. 80,000
Bread (BR)	Tk. 35,000
Maintenance (M)	Tk. 12,000
Cleaning (C)	Tk. 8,000

Contd P/8

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Contd... Q. No. 8

The reallocation percentages of the service departments' costs are given below:

Department	CK	BC	BR	M	C
M	40%	25%	25%	—	10%
C	25%	30%	30%	15%	—

Required: Reallocate the overheads of service departments to production departments using Equation Method.

(b) A firm considering the following two mutually exclusive investments: **(22)**

Cash Flows (Tk.)				
Projects	C_0	C_1	C_2	C_3
X	–25,000	+5000	+5000	+25640
Y	–28,000	+12672	+12672	+12672

The cost of capital is 12%.

Required:

(i) Compute NPV for each project.

(ii) Compute IRR for each project.

The table Value may be used as given below:

	Factors Value						
Year	14%	15%	16%	17%	18%	19%	20%
3	2.322	2.283	2.246	2.210	2.174	2.140	2.106

(iii) Which project should be undertaken and why?

(iv) Write down the dis-advantages of discounted cash flow approach.

L-3/T-1/EEE **Date: 23/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **EEE 307** (Electrical Properties of Materials)

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**.

The symbols have their usual meanings. Assume reasonable values for any missing data.

1. (a) Si has the diamond and GaAs has the zinc blende crystal structure. Given the lattice parameters of Si and GaAs, a = 0.543 nm and a = 0.565 nm, respectively, and the atomic masses of Si, Ga, and As as 28.08 g/mol, 69.73 g/mol, and 74.92 g/mol, respectively. Calculate the density of Si and GaAs. What is the atomic concentration (atoms per unit volume) in each crystal? **(20)**

   (b) Draw the followings in a cubic unit cell. **(15)**

   (i) (110) (ii) (121) (iii) (234) (iv) [111] and (v) [123]

2. (a) A photoelectric experiment indicates that violet light of wavelength 420 nm is the longest wavelength radiation that can cause photoemission of electrons from a particular photocathode surface. **(20)**

   (i) What is the work function in eV?

   (ii) If a UV radiation of wavelength 300 nm is incident upon the photocathode, what will be the maximum kinetic energy of the photoemitted electrons, in eV?

   (iii) Given that the UV light of wavelength 300 nm has an intensity of 20 mW/cm^2. If the emitted electrons are collected by applying a positive bias to the opposite electrode, what will be the photoelectric current density?

   (b) Constantan has the composition of 45% Ni-55% Cu. Cu-Ni alloys show complete solid solubility. Given that the resistivity and TCR of copper at 20°C are 17 nΩ m and 0.004 K^{-1}, respectively, and the Nordheim coefficient of Ni dissolved in Cu is 1570 nΩ m, calculate the resistivity, TCR, and thermal conductivity of constantan. **(15)**

3. (a) Find the expressions of quantized energy levels and the corresponding wave functions in an infinite 2D potential well. **(20)**

   (b) Calculate the probability of finding an electron at the ground state in an infinite 1D potential well between 0.25W and 0.75W, where W is the width of the well. **(15)**

4. (a) What is the origin of bandgap in a crystal and why the discrete energy levels of atoms form many 'continuous' bands? Explain briefly using Kronig-Penney model. **(20)**

   (b) Define density of states. Show that 2D density of states function for a free electron is independent of energy. **(15)**

Contd P/2

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SECTION – B

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

5. (a) The density of liquid xenon (Z=56) is 3.0 g cm^{-3} and its atomic mass is 131.3 gm/mol. The electronic polarizability of xenon atom is 4.4×10^{-40} Fm^2. For xenon atom calculate the electronic polarization resonant frequency, the restoring force constant, and the relative permittivity. **(20)**

(b) Given the static dielectric constant of water as 80, its high frequency dielectric constant (due to electronic polarization) as 4, its density as 1 g cm^{-3}. Calculate the permanent dipole moment p_0 per water molecule assuming that it is the orientational and electronic polarization of individual molecule that give rise to the dielectric constant. **(15)**

6. (a) Derive the expression of ionic polarizability when an ac field is applied to an ionic crystal. Also show the frequency dependence of the real and imaginary parts of the normalized polarizability. **(20)**

(b) Consider a CsBr crystal (one Cs^+-Br^- pair per unit cell) with a lattice parameter (a) of 0.430 nm. The electronic polarizability of Cs^+ and Br^- ions are 3.35×10^{-40} F m^2 and 4.5×10^{-40} F m^2, respectively, and the mean ionic polarizability per ion pair is 5.8×10^{-40} F m^2. What is the low frequency dielectric constant? **(15)**

7. (a) Consider bismuth with $\chi_m = -16.6\times10^{-5}$ and aluminum with $\chi_m = 2.3\times10^{-5}$. Suppose that each sample is subjected to an applied magnetic field B_0 of 1 T applied in the $+x$ direction. What is the magnetization M and the equivalent magnetic field $\mu_0 M$ in each sample? Which is paramagnetic and which is diamagnetic? **(20)**

(b) The saturation magnetization (M_{sat}) in iron is about 1.75×10^6 A m^{-1}. Calculate the effective number of Bohr magnetons per atom that would give M_{sat}, given that the density and relative atomic mass of iron are 7.86 g cm^{-3} and 55.85, respectively. Also calculate the resulting magnetic field within the iron specimen when the magnetization is saturated in the absence of an applied magnetizing field (H = 0). **(15)**

8. (a) Consider a superconducting solenoid that is 10 cm in diameter and 1 m in length and has 500 turns of Nb_3Sn wire, whose critical field B_c at 4.2 K (liquid He temperature) is about 20 T and critical current density J_c is 3×10^6 A cm^{-2}. The coil wire radius is 1 mm. What is the current necessary to set up a field of 5 T at the center of a solenoid? Assume that 20 percent by cross-sectional area (and hence as volume percentage) of the coil wire is the superconductor. Also assume that the field across the diameter of the solenoid is approximately uniform. Calculate the critical current density at a field of 5 T assuming that the critical current density decreases linearly with the applied field. **(20)**

(b) The Fermi energy of calcium, E_F is 4.68 eV. Evaluate the paramagnetic susceptibility of calcium and compare with the experimental value of 1.9×10^{-5}. **(15)**

L-3/T-1/EEE **Date: 29/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **EEE 305** (Power System 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) Establish relationship between the ohmic values of per-phase impedances from one side of a 3-phase transformer to another for the following transformer connections: **(15)**

$$Y-Y, Y-\Delta, \Delta-Y \text{ and } \Delta-\Delta$$

(b) The figure shows a three-phase generator rated 300 MVA, 23 kV supplying a system load of 240 MVA, 0.9 power-factor lagging at 230 kV through a 330-MVA 23Δ/230Y-kV step-up transfer of leakage reactance 11%. Neglecting magnetizing current and choosing base values a the load of 100 MVA and 230 kV, find I_A, I_B, and I_C supplied to the load in per unit with V_A as reference. Specifying the proper base for the generator circuit, determine I_a, I_b, and I_c from the generator and its terminal voltage. Also, determine the real power supplied by the generator in per unit. **(15)**

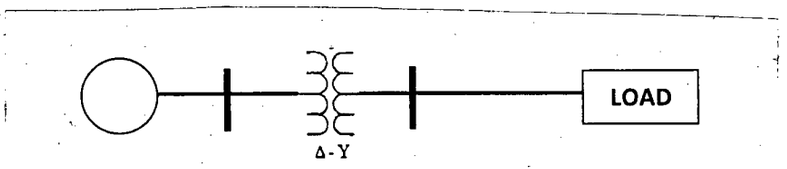

Figure for Q. 1(b)

(c) Why per unit method of representation is extensively used in power system studies? **(5)**

2. (a) Show that the voltage at any point along a long transmission line is the sum of two waves travelling in opposite directions. **(14)**

(b) Discuss propagation constant, characteristic impedance and surge impedance loading with reference to a long transmission line model. **(9)**

(c) A three-phase transmission line is 300 mile long and serves a load of 400 MVA, with 0.8 lagging power factor at 345 kV. The ABCD constants of the line are **(12)**

$A = D = 0.8180 \angle 1.3°$, $B = 172.2 \angle 84.2° \Omega$ $C = 0.019330 \angle 90.4° S$

(i) Determine the sending-end line-to-neutral voltage, the sending-end current, and the percent voltage drop at full load.

(ii) Determine the receiving-end line-to-neutral voltage at no load, the sending-end current at no load, and the voltage regulation.

Contd P/2

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3. (a) What is the function of the 'slack bus' in the problem formulation and solution of the power flow problem? **(5)**

(b) Describe how voltage controlled busses are treated in the Gauss-Seidel method of power flow solution. **(10)**

(c) Evaluate both diagonal and off-diagonal elements of the Jacobian element J_{12}. **(10)**

(d) Two reactances $X_1 = 0.08$ and $X_2 = 0.12$ per unit are in parallel between two buses a and b in a power system. If $V_a = 1.05\angle 10°$ and $V_b = 1.0\angle 0°$ per unit, what should be the turns ratio of the regulating transformer to be inserted in series with X_2 at bus b so that no vars flow into bus b from the branch whose reactance is X_1? Neglect the reactance of the regulating transformer. P and Q of the load and V_b remain constant. **(10)**

4. (a) Draw and explain the typical current and voltage wave shapes in a circuit breaker during fault clearing. **(8)**

(b) Explain the following ratings of a circuit breaker: **(10)**

(i) Rated short-circuit breaking current

(ii) Rated short-circuit making current

(iii) Rated power frequency withstand voltage

(iv) Lightning impulse withstand voltage.

(c) Name some of the relay actuating quantities. Present a conceptual diagram of a relay with a brief explanation. **(10)**

(d) Present a simple impedance relay using balanced beam structure. **(7)**

SECTION – B

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

All the symbols have their usual meaning.

5. (a) A synchronous generator is connected to a synchronous motor by a line with impedance of j0.1 pu. The sub-transient reactance of the generator and motor are j0.2 pu and j0.18 pu respectively. If a symmetrical fault occurs at motor terminal, determine fault current. Assume the pre-fault voltage at motor terminal to be 0.9 pu. **(10)**

(b) For the network shown below, using "step-by-step Z_{Bus} building algorithm", determine the bus impedance matrix. **(20+5)**

Assume a 3-phase fault occurs at bus 2, find (i) fault current, (ii) fault MVA and (iii) voltage on each bus in the system.

The reactances of the lines are given in pu. Assume the pre-fault voltages at each bus is 1.0 pu.

Contd P/3

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Contd... Q. No. 5(b)

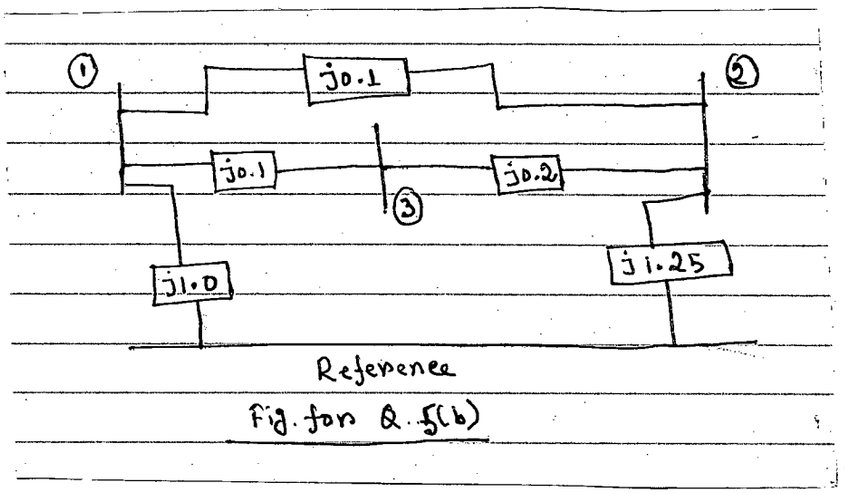

Fig. for Q. 5(b)

6. (a) Show that for a double line to ground fault at phase b and phase c of an unloaded generator, **(15)**

$$I_{a1} = \frac{Ea}{Z_1 + (Z_0 \parallel Z_2)}$$

where all the symbols have their usual meaning.

(b) Calculate three phase fault current and short-circuit level for the network shown below when fault occurs at bus 1 and 2 in separate cases. Assume 11 kV and 300 MVA as base quantities at the generator end. **(20)**

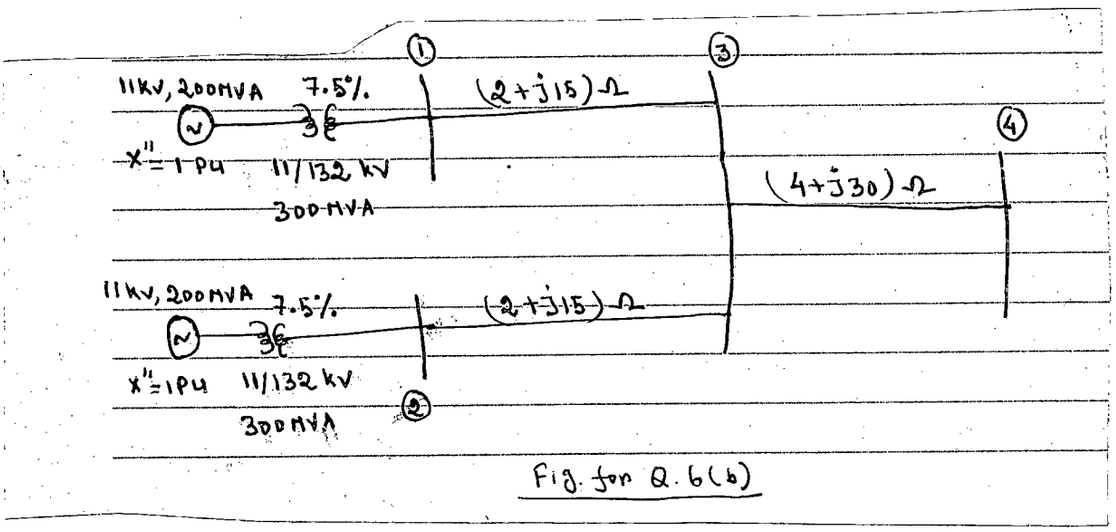

Fig. for Q. 6(b)

7. For the power system shown in figure below, the following faults occurs at bus-2 in three separate cases. **(35)**

   (i) Single line to ground fault at phase 'a'

   (ii) Double line fault between phase 'b' and 'c'

   (iii) Double line to ground fault at phase 'b' and 'c'.

Contd P/4

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Contd... q. N o. 7

If the fault impedance is j0.02 pu and pre-fault voltage at bus-2 is 1.03 pu for all the cases, determine fault current in pu.

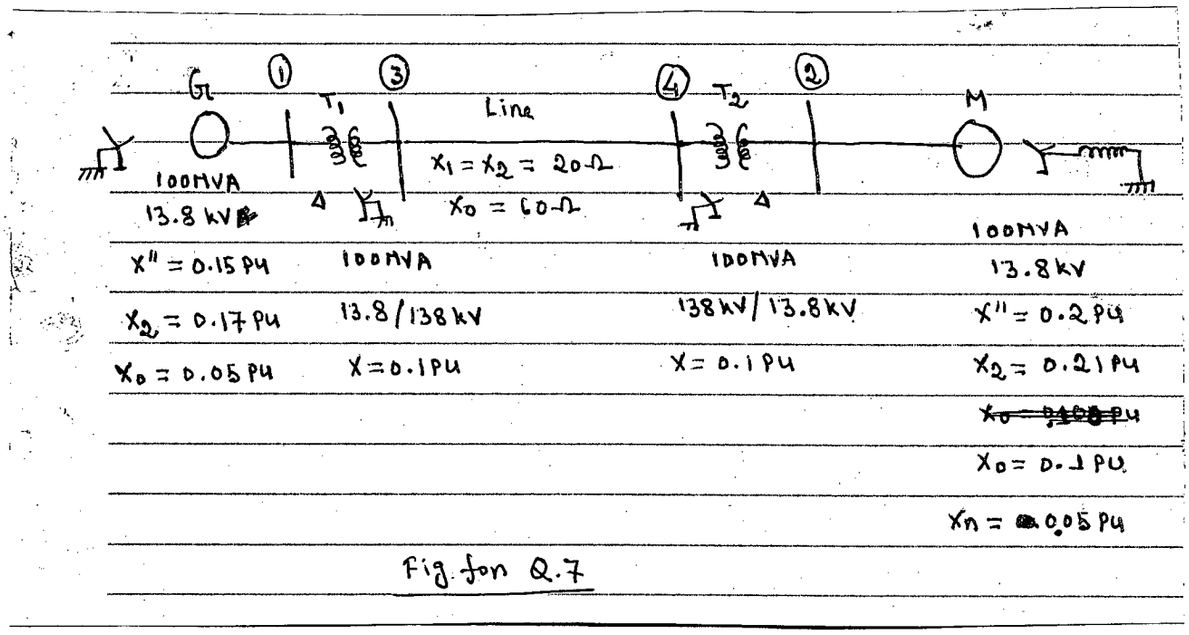

Fig for Q.7

8. (a) Consider a two bus power system, where these buses are connected through two parallel transmission lines. The impedances of each line is j0.2 pu. Each line in the power system has line changing capacitive susceptance of jy pu. If the elements of Y_{Bus} are: **(10)**

$Y_{11} = -j9.96$, $Y_{12} = Y_{21} = j10$, $Y_{22} = -j9.96$, determine the value of y.

(b) Draw the block diagram of a combined cycle power plant. **(5)**

(c) A power plant has a maximum demand of 15,000 kW. The annual load factor is 60% and plant capacity factor is 50%. Determine the annual reserve energy of the plant. **(10)**

(d) For a single line to ground fault occurring at phase 'a' of an unloaded generator, the positive, negative and zero sequence voltages of phase 'a' are 0.643 pu, –0.5 pu and -0.143 pu respectively. Determine line to line voltages (V_{ab}, V_{bc} and V_{ca}) in pu. **(10)**
