L-3/T-2/EEE **Date : 07/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 351** (Analog Integrated Circuits)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

All the symbols and notations used have their usual meanings.

SECTION – A

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

1. (a) Prepare a table of comparison featuring the key aspects of discrete versus integrated analog circuit design. What do you understand by '*Electrical Design*' and '*Physical Design*'? **(10)**

(b) Explain with necessary illustrations why the *Shallow Trench Isolation* (STI) technology is used in *Deep Submicron* CMOS process? Give example of isolating three (3) types of resistors to be fabricated on the same substrate using STI. **(10)**

(c) Draw the capacitance-voltage characteristics of a PMOS device. Also rearrange the following layout shown in the Fig. for Q. No. 1(c) so that the gate resistance reduces to half of the initial resistance (assume channel length L is constant). **(15)**

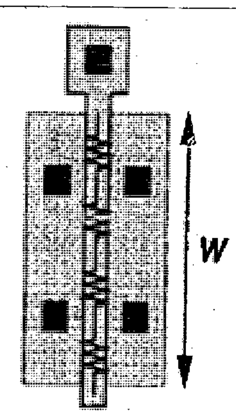

Fig. for Q. No. 1(c)

2. (a) Draw the *analog design octagon* showing appropriate links between conners of the octagon through diagonal paths. Also derive the voltage gain of a single-stage CS amplifier with resistive load. **(10)**

(b) Explain why the output voltage levels will be different even though the same input is applied to the NMOS or PMOS pass transistors/CMOS transmission gate switches of equivalent size. Also define the *charge injection* and *clock feed-through* problems of switched capacitor circuits. **(10)**

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Contd... Q. No. 2

(c) Calculate the output impedance of the folded cascode circuit shown in the Fig. for Q. No. 2(c) where M_3 operates as a current source and compare this output impedance with that of a nonfolded cascode. Assume that $g_{m1} = g_{m2} = g_{m3} = 0.3$ Siemens, $g_{mb2} = 0.1$ Siemens, and $r_{O1} = r_{O2} = r_{O3} = 50$ MΩ. **(15)**

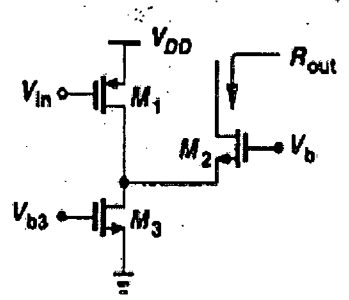

Fig. for Q. No. 2(c)

3. (a) Explain the operation of the unity-gain sampler in slow motion for both the sampling and the amplifying modes. Also generate proper clock edges for this unity-gain sampler. **(10)**

(b) Draw the precision multiply-by-two circuit and show it's transition to amplification mode. Explain the operation of this precision circuit. **(10)**

(c) Show the effect of junction capacitance nonlinearity in *Switched Capacitor* (SC) integrator. Design a parasitic-insensitive *SC* integrator and draw it's equivalent circuits both for the sampling and the integration modes. **(15)**

4. (a) What is an Op-Amp? Draw the linear and dynamic characteristics of the CMOS Op-Amp. Also elaborate the terms: PSRR, ICMR, and SR. **(10)**

(b) Draw the compensated open-loop frequency/phase responses of the two-stage Op Amp. 'In self-compensated Op Amp, the GB changes but in Miller compensation GB remains unchanged' – justify. **(10)**

(c) If

$K_N = 100\mu A/V^2,\ K_P = 20\mu A/V^2,\ V_{TN} = |V_{TP}| = 0.4V,\ \lambda_N = 0.06/V,\ \lambda_P = 0.08/V,$

design a 2-stage CMOS Op-Amp that will meet the following specifications: **(15)**

$A_v > 3000,\ V_{DD} = 2.5\ V, GB = 4\ MBz, SR > 10V/\mu s, P_{diss} < 3mW, 0.25\ V < V_{out} < 2V, 1.2V < ICMR < 2V,$ and 60° phase margin.

Suppose that the channel length to be $0.5\mu m$ and the load capacitor $C_L = 10pF$. Assume any other data, if required.

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SECTION – B

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

5. (a) What is half circuit concept? Prove it. **(15)**

Using half circuit concept calculate the differential gain of the circuit shown in Fig. for Q. 5(a).

(b) In the circuit shown in Fig. for Q. 5(b), M_2 is twice as wide as M_1. **(20)**

(i) Calculate the small signal gain if the bias values of V_{in1} and V_{in2} are equal.

(ii) Sketch I_{D1} and I_{D2} versus $V_{in1}-V_{in2}$. For what values of $V_{in1}-V_{in2}$ are the two currents equal.

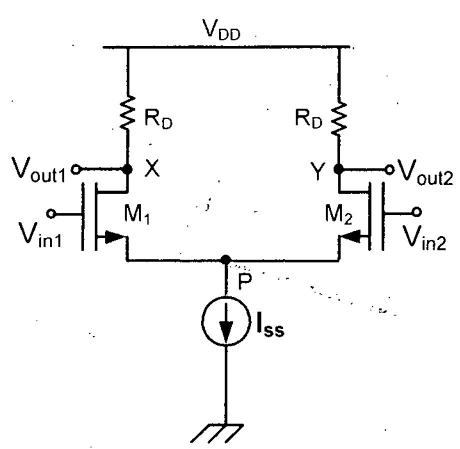

Fig. for Q 5(a)

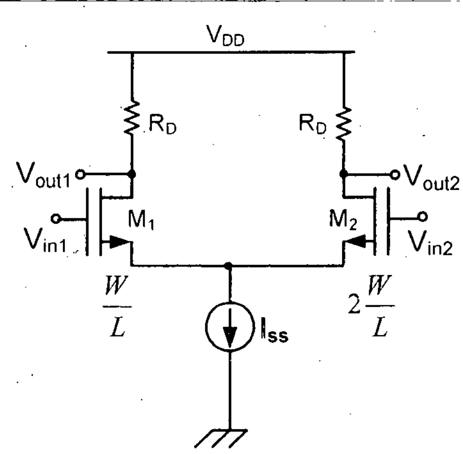

Fig. for Q 5(b)

6. (a) "Even if the gate-source voltage of a MOSFET is precisely defined, its drain current is not!" Explain this statement with example and show how this problem is overcome by copying currents from a available reference. **(13)**

(b) For the circuit shown in Fig. for Q. 6(b), find the drain current of M4 in terms of I_{REF} and device dimensions. Assume all the transistors are in saturation. **(10)**

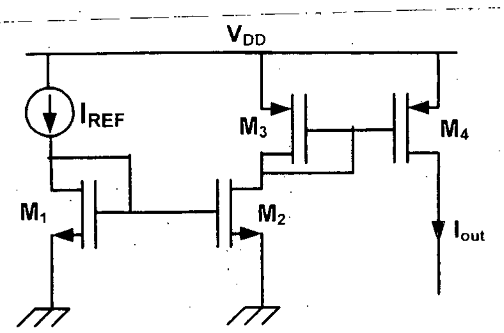

Fig. for Q 6(b)

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Contd... Q. No. 6

(c) Calculate the differential gain of the differential pair with active current mirror circuit shown in Fig. for Q. 6(c). Assume $\gamma = 0$ and make any other necessary assumptions. **(12)**

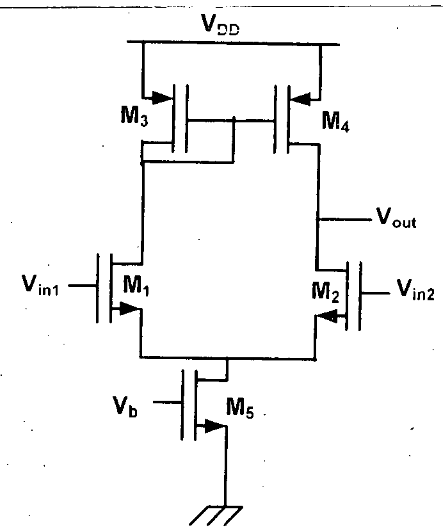

Fig. for Q 6(c)

7. (a) Prove that, superposition can be applied for two uncorrelated noise sources. Also show that polarity does not matter for this addition. **(10)**

(b) Find the maximum noise voltage that a single MOSFET can generate. **(10)**

(c) Calculate the input-referred thermal noise voltage of the circuit shown in Fig. for Q. 7(c). **(15)**

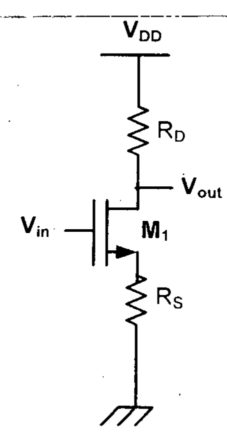

Fig. for Q 7(c)

8. (a) If $V_{TH1} = V_{TH2}$ and $\lambda = 0$, prove that the current I_{out} produced by the circuit shown in Fig. for Q. 8(a) does not depend on power supply. Why do we need a startup circuit to operate this system? Draw a suitable start-up for this circuit and explain its operation. **(18)**

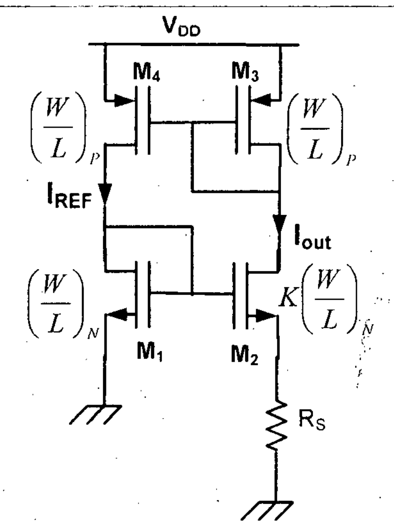

Fig. for Q 8(a)

(b) Draw the circuit diagram of a proportional to absolute temperature (PTAT) current generator and explain its operation. Show how this circuit can be modified to built a temperature independent reference voltage. **(17)**

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 331** (Random Signals and Processes)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

Symbols have their usual meanings.

SECTION – A

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

The questions are of equal value.

1. (a) Explain why the following functions can or cannot be the power spectral densities of a real WSS process X(t):

   (i) $S_{XX}(\omega) = \dfrac{24}{\omega^2 + 16}$

   (ii) $S_{XX}(\omega) = \dfrac{\sin\omega}{\omega}$

   (iii) $S_{XX}(\omega) = \delta(\omega) + \dfrac{5\omega^2}{1 + 3\omega^2 + 4\omega^4}$

   (iv) $S_{XX}(\omega) = 4 - \omega^4/9$.

   (b) Determine the power spectral density of a WSS process whose autocorrelation function is given by

   $$R_{XX}(\tau) = 2e^{-|\tau|} + 4e^{-4|\tau|}$$

   Also, find variance σ_x^2. Next, determine the average power of X(t) from $R_{XX}(\tau)$ as well as from $S_{XX}(\omega)$

2. (a) The impulse response of an LTI system is given by

   $$h(t) = e^{-2|t|}$$

   Let Y(t) = $h(t) \otimes X(t)$ and $Z(t) = X(t) - Y(t)$, $X(t)$ is a WSS process whose power spectral density is given by

   $$S_{XX}(\omega) = \frac{4}{\omega^2 + 4}$$

   Determine if $Y(t)$ and $Z(t)$ have derivatives in the mean-square sense (MSS) using $S_{YY}(\omega)$ and $S_{ZZ}(\omega)$.

   (b) A random process $X(t)$ is given by

   $$X(t) = A\cos(\omega t + \varphi)$$

   where ω is a constant, φ ~U(0, 2π) follows a uniform distribution and A is a discrete random variable which has a value of +1 and –1 with equal probability. φ and A are independent random variables. Find if $X(t)$ is a WSS process.

3. (a) Find if $X(t)$ in Q. 2(b) is mean-ergodic and correlation-ergodic in the mean square sense (MSS).

   (b) Determine the reliabilities of the two networks shown in Figs. For Q. 3(b)(i) and 3(b)(ii). The components (S_k) are independent and have an identical reliability of 0.99.

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

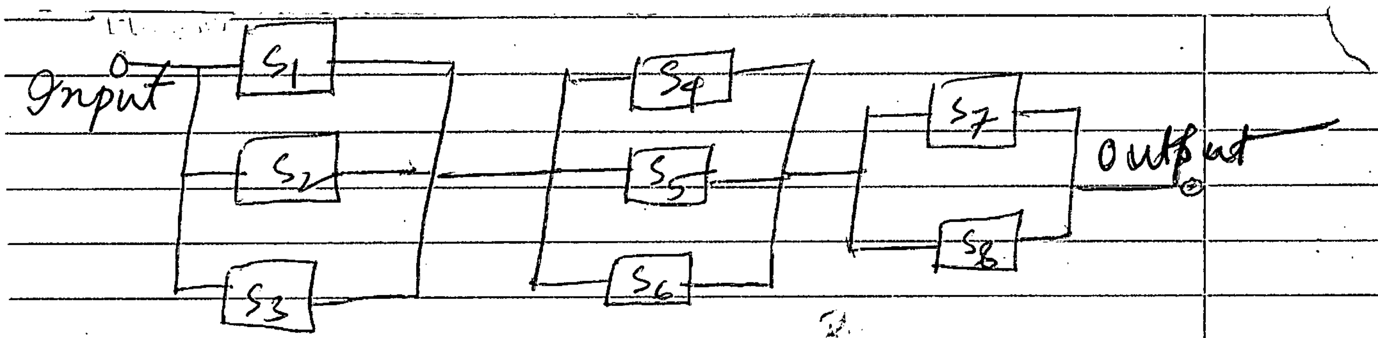

Fig. for Q 3(a) (i)

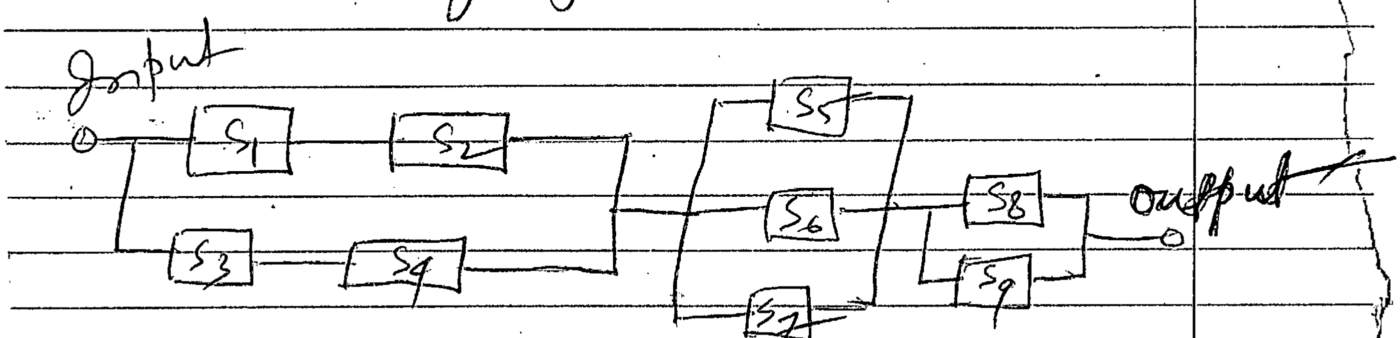

Fig. for Q. 3(b) (ii)

4. (a) Find the frequency response of the matched filter that receives the signal $r(t)$, where $r(t) = s(t) + n(t)$; $s(t)$ is shown in Fig. for Q. 4(a) and $n(t)$ is a WSS noise process with unity power spectral density. The signal-to-noise ratio is to be maximized at $t = t_0$. Next, find the output of the matched filter. Also, draw the block diagram of the matched filter showing its various components.

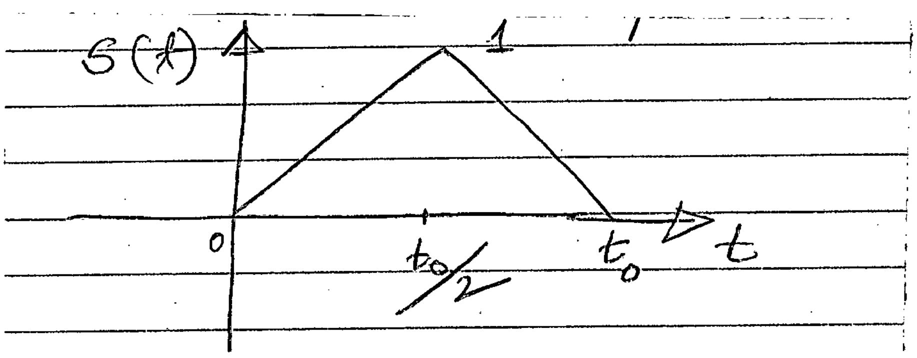

Fig. for Q. 4 (a)

(b) State and prove the Central Limit theorem.

SECTION – B

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

The figures in the margin indicate full marks.

5. (a) In three boxes there are capacitors as shown in Table for Q. 5(a). An experiment consists of first selecting a box, assuming each has the same likelihood of selection, and then selecting a capacitor from the chosen box. **(17)**

   (i) What is the probability of selecting a 0.01 μF capacitor, given that box 2 is selected?

   (ii) If a 0.01 μF capacitor is selected, what is the probability it came from box 3?

Table for Capacitors (Table for Q. 5(a))

Value (μF)	Number in box			
	1	2	3	Total
0.01	15	80	55	150
0.1	75	55	90	220
1.0	50	60	125	235
Total	140	195	270	605

(b) The transmitter of communication system shown in Fig. for Q. 5(b) has three transmitted symbols 0, 1 and 2. In Fig. 5(b), A_i and B_i, i = 1, 2, 3, represent symbols after and before the channel, respectively. Assume channel transition probabilities are all equal at $P(A_i \mid B_j) = 0.1$, $i \neq j$ and are $P(A_i \mid B_j) = 0.8$ for $i = j$ = 1, 2, 3, while symbols transmission probabilities are $P(B_1) = 0.5$, $P(B_2) = 0.3$, and $P(B_3) = 0.2$. **(18)**

   (i) Compute $P(A_1)$, $P(A_2)$, and $P(A_3)$.

   (ii) Compute $P(B_1 \mid A_1)$, $P(B_2 \mid A_2)$, and $P(B_3 \mid A_3)$.

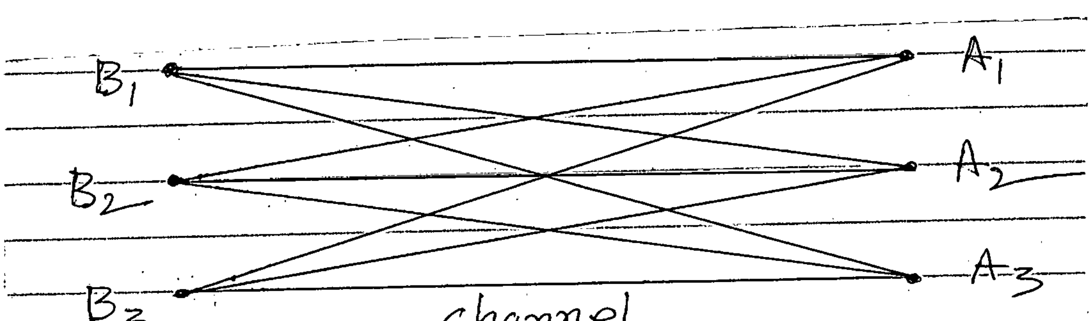

Fig. for Q. 5(b)

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6\. (a) Suppose height to the bottom of clouds is a Gaussian random variable, X with mean 4000 m and standard deviation 1000 m. A person bets that cloud height tomorrow will fall in the set $A = \{900\, m < X \le 3000\, m\}$ while a second person bets that height will be satisfied by $B = \{2100\, m < X \le 4000\, m\}$. A third person bets they are both correct. Find the probabilities that each person will win the bet. If required, use the following approximation for Q-function- **(17)**

$$Q(x) \approx \left[\frac{1}{(1-0.339)x + 0.339\sqrt{x^2 + 5.510}} \right] \frac{e^{-x^2/2}}{\sqrt{2\pi}}, \quad x \ge 0$$

(b) The envelope (amplitude) of the output signal of a radar system that is received only noise (no signal) is a random variable, X with density function $xe^{-x^2/2}u(x)$. The system gets a false target detection if X exceeds a threshold level V volts. How large must V be to make the probability of false detection 0.001? **(18)**

7\. (a) The joint probability density function of X and Y is defined as **(12)**

$$f_{XY}(x,y) = \begin{cases} 6x, & x \ge 0,\, y \ge 0,\, x + y \le 1 \\ 0, & otherwise \end{cases}$$

Find the probability density function of $Z = X - Y$.

(b) Let the joint probability function of X and Y be given by **(23)**

$$f_{XY}(x,y) = \begin{cases} e^{-x}, & 0 < y \le x \le \infty \\ 0, & otherwise \end{cases}$$

Define $Z = X + Y$, $W = X - Y$.

Find the joint probability density function of Z and W. Are Z and W independent random variables? Are Z and W correlated?

8\. (a) Two random variables X and Y are defined by $\overline{X} = 0, \overline{Y} = -1, \overline{X^2} = 2, \overline{Y^2} = 4$ and $R_{XY} = -2$. Two new random variables W and U are $W = 2X + Y$ and $U = -X - 3Y$. Find $\overline{W}, \overline{U}, \overline{W^2}, \overline{U^2}, \sigma_X^2, \sigma_Y^2, \sigma_W^2, \sigma_U^2$. **(15)**

(b) Let the joint probability function of X and Y be given by **(20)**

$$f_{XY}(x,y) = \begin{cases} 2e^{-(x+y)}, & 0 < x < y < \infty \\ 0, & otherwise \end{cases}$$

Determine

(i) $f_X(x)$ and $f_Y(y)$

(ii) $f_{X/Y}(x/y)$ and $f_{Y/X}(y/x)$

(iii) $\text{cov}(X,Y)$ and ρ_{XY}.

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Table E.1 Common Fourier Transform Pairs

Signal (time domain)	Transform (frequency domain)
$\mathrm{rect}(t/t_o)$	$t_o\mathrm{sinc}(ft_o)$
$\mathrm{tri}(t/t_o)$	$t_o\mathrm{sinc}^2(ft_o)$
$\exp\left(-\frac{t}{t_o}\right)u(t)$	$\frac{t_o}{1+j2\pi ft_o}$
$\exp\left(-\frac{\|t\|}{t_o}\right)$	$\frac{2t_o}{1+(2\pi ft_o)^2}$
$\mathrm{sinc}(t/t_o)$	$t_o\mathrm{rect}(ft_o)$
$\mathrm{sinc}^2(t/t_o)$	$t_o\mathrm{tri}(ft_o)$
$\exp(j2\pi f_o t)$	$\delta(f-f_o)$
$\cos(2\pi f_o t+\theta)$	$\frac{1}{2}\delta(f-f_o)e^{j\theta}+\frac{1}{2}\delta(f+f_o)e^{-j\theta}$
$\delta(t-t_o)$	$\exp(-j2\pi ft_o)$
$\mathrm{sgn}(t)$	$\frac{1}{j\pi f}$
$u(t)$	$\frac{1}{2}\delta(f)+\frac{1}{j2\pi f}$
$\exp(-(t/t_o)^2)$	$\sqrt{\pi t_o^2}\exp(-(\pi ft_o)^2)$

L-3/T-2/EEE **Date : 07/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 371** (Power System II)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

All symbols have their usual significance.

1. The machine-2 in a system was delivering 1.8 p.u. power to an infinite bus and was at a rotor position of 16° before a solid 3-phase fault occurred on a certain line in the system. The machine inertia constant is 8 MJ/MVA on the system base. The system frequency is 50 Hz. The fault was cleared at 0.3 seconds. The power transferability of the machine during the fault and after clearing the fault are respectively as follows.

$$P_{e,df} = 0.1545 + 5.5023\sin\left(\delta_2 - 0.755^{\circ}\right)$$

$$P_{e,af} = 0.1804 + 6.4934\sin\left(\delta_2 - 0.847^{\circ}\right)$$

(a) Write the swing equations during and after faults. **(10)**

(b) Using the step by step algorithm computer t vs. δ_2 starting at t = 0 at an interval $\Delta t = 0.1$ sec and up to 0.4 seconds. In each step detailed calculations must be shown of P_a, $kP_{a,n-1}$, $\Delta\delta_{2n}$, δ_{2n}, f_n and put their values in a Table. The symbols have usual meanings. **(25)**

2. (a) What do you mean by Flexible AC Transmission Systems (FACTS)? **(10)**

(b) Describe with neat diagrams at least three FACTS devices that can cause phase shift and hence change real power flow through a line. **(25)**

3. (a) Prove that in a HVDC system the current does not depend upon the load at the receiving end. **(8)**

(b) Describe with neat diagrams the BTB-HVDC interconnection between India and Bangladesh. **(18)**

(c) Show with a diagram a comparison of cost versus distance for HVAC and HVDC systems. **(9)**

4. (a) How is cable rating selected for a load to be served at low voltage ($\leq 1\,\text{kV}$) and high voltage ($\geq 11\,\text{kV}$)? **(8)**

Contd P/2

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Contd... Q. No. 4

(b) What is flicker? Prove that the short circuit capacity at the PCC where an electric arc furnace is to be connected should be at least 75 times the short circuit rating of the furnace. **(3+8)**

(c) Define THD and TDD. What are their permissible limits for current and voltages at a PCC voltage of less than 69 kV, according to IEEE 519-1992 standard? Discuss with diagrams an active and a passive filter for harmonics remedy. **(4+4+8)**

SECTION – B

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

5. (a) Derive an expression for flux linkages of one conductor in a group. **(12)**

(b) Derive an expression for inductance of a three-phase single circuit line with unsymmetrical spacing. **(13)**

(c) Each conductor of the bundled-conductor line shown in Fig. 5(c) is ACSR, 127000-cmil pheasant where $D_s = 0.0466$ ft. Find the inductive reactance in ohms per kilometer per phase for d = 45 cm. **(10)**

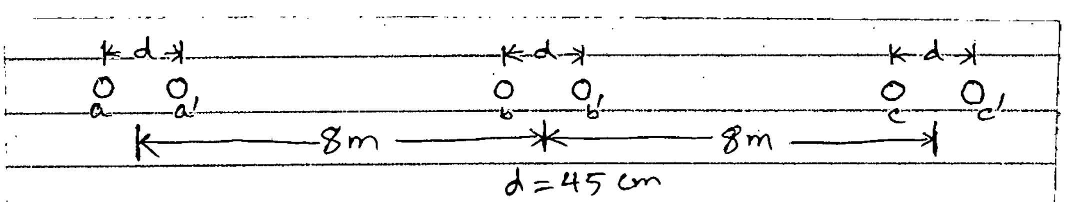

Fig. 5(c)

6. (a) Derive an expression for capacitance of a three-phase line with (i) equilateral spacing, (ii) unsymmetrical spacing. **(24)**

(b) A three-phase, 50 Hz, 66 kV single circuit overhead line conductors are placed in a horizontal plane as shown in Fig. 6(b). The conductor diameter is 1.25 cm. If the line is 100 Km, calculate capacitance to neutral per phase. **(11)**

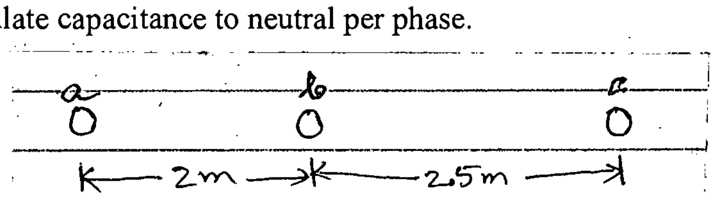

Fig. 6(b)

7. (a) Derive the second-order differential equation which governs the rotational dynamics of a synchronous machine in stability study. **(13)**

Contd P/3

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Contd... Q. No. 7

(b) Derive an expression for critical clearing time for an OMIB (one machine to infinite bus) system when power transfer during fault is zero. **(12)**

(c) The single-line diagram of Fig. 7(c) shows a generator connected through parallel transmission lines to a large metropolitan system considered as an infinite bus. The machine is delivering 1.0 per-unit power and both the terminal voltage and the infinite bus voltage are 1.0 per unit. Numbers on the diagram indicate the values of the reactances on a common system base. The transient reactance of the generator is 0.2 per unit as indicated. Determine the power angle equation for the given system operating conditions. **(10)**

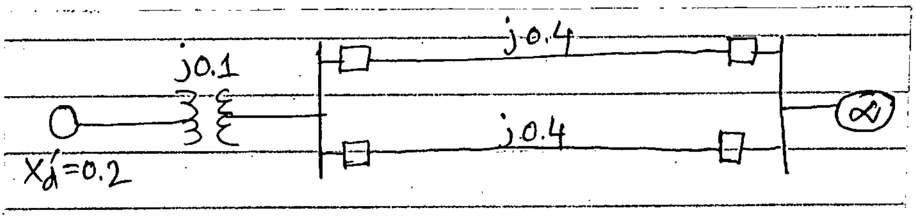

Fig. 7(c)

8. (a) Describe the equal-area criterion for power system stability analysis. **(11)**

(b) Derive an expression for capacitance calculation for bundled conductor. **(11)**

(c) One circuit of a single-phase transmission line is composed of three solid 0.25 cm radius wires. The return circuit is composed of two 0.5 cm radius wires. The arrangement of conductors is shown in Fig. 8(c). Find the inductance due to the current in each side of the line and the inductance of the complete line in henrys per meter. **(13)**

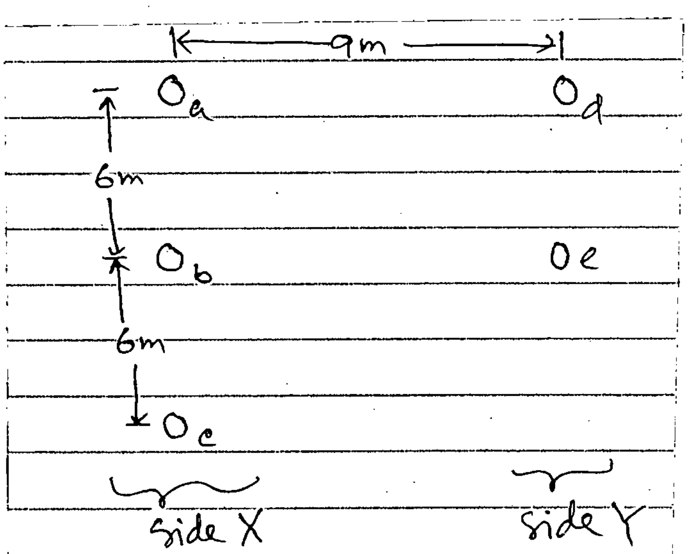

Fig. 8(c)

L-3/T-2/EEE **Date : 17/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 309** (Communication Theory)

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. Symbols have their usual meanings. Make reasonable assumptions on any missing information.

1. (a) Name the techniques for countering noise in communication systems. With necessary diagram, explain the technique that uses amplifiers along the transmission path. **(8)**

(b) Propagation constant of a transmission media is given as $\gamma = (\omega/10\pi + \omega^2/50\pi^2) + j(6\pi + 10^{-6}\,\omega^2)$ per km. Two message signals to be transmitted are $m_1(t) = 10\cos(12\pi t) + 6\cos(20\pi t)$, and $m_2(t) = 8\cos(20\pi t)$. **(6+6)**

(i) Determine whether $m_1(t)$ and $m_2(t)$ can be received without any distortion.

(ii) If the length of the cable is 2 km, find the expression of the received signal for $m_1(t)$.

(c) For the cascaded system shown in Fig. for Q. No. 1(c), noise power at the output of Amplifier 1 is – 85 dBm. Calculate the (i) NF of the overall system, (ii) SNR at the input and the output of Amplifier 2, and (iii) noise temperature of the two amplifiers. **(15)**

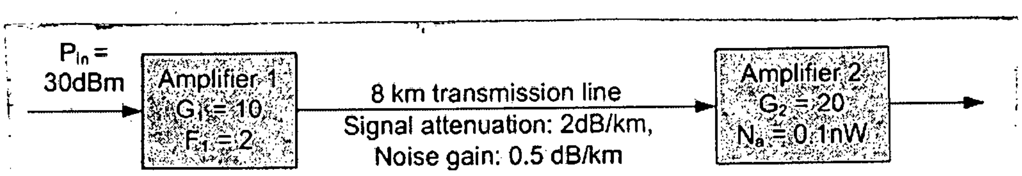

Fig. for Q. No. 1(c)

2. (a) Explain the operation of a double-balanced DSB-SC AM modulator. Why is the modulator called 'double-balanced'? **(8+4)**

(b) Consider a DSB+C AM based communication system with message $m(t) = 8\cos(10000\,\pi t) + 6\cos(20000\pi t)$ and carrier $c(t) = 5\cos(2\pi \times 10^6)t$. **(16)**

(i) Calculate the minimum carrier amplitude required for using envelope detector?

(ii) Calculate the modulation index, total transmitted power and the power efficiency.

(iii) What kind of detection should be used in the receiver? Justify your answer.

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

(v) For the given $m(t)$ and $c(t)$, determine the bandwidth of DSB+C and SSB+C signals.

(vi) If the carrier frequency is now doubled, repeat part (v).

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Contd … Q. No. 2

(c) With necessary diagrams, explain the weaver method for generating SSB AM signal. **(7)**

3. (a) Derive the generalized time-domain expression of FM signal for a single-tone message. Then show that the bandwidth of NBFM signal is equal to that of DSB AM signal. **(10+4)**

(b) Consider an FM system with a single-tone message with amplitude A_m=2 volt and frequency f_m=4 kHz. The carrier has an amplitude A_c=4 volt and frequency f_c = 1 MHz. The system uses a modulation index β for which the carrier in the FM signal has 30% of the total transmitted power. Now using the attached Bessel function plot in Fig. for Q. No. 3(b). answer the following questions. **(14)**

(i) What is the modulation index β of the system?

(ii) Determine the bandwidth using the Carson's rule.

(iii) Draw the FM amplitude spectrum.

(iv) Calculate the percentage of power contained within the bandwidth found in part (ii).

(v) Calculate the bandwidth of the FM signal using the 1% rule.

(c) For a message signal $m(t) = 8t + 4\cos(4000\pi t)$ and carrier $c(t) = 2\cos(2\pi\times10^6)t$, derive the expressions of PM and FM signals. Given, frequency sensitivity k_f = 1000 Hz/V and phase sensitivity $k_p = 4\pi$ rad/V. Also find the power of the modulated signal. **(7)**

4. (a) Draw the block diagram of a QAM system. Derive the expression of reconstructed in-phase channel (I-channel) signal if both the frequency and the phase of the receiver carrier are different than those of transmitter side carrier. **(4+6)**

(b) Derive the mathematical relationship between vestigial shaping filter at the transmitter and the LPF at the receiver in a VSB based communication systems. Also explain why VSB+C is preferred for TV signal transmission. **(8+5)**

(c) Define pulse modulation. With necessary diagrams, discuss in detail the impact of pulse width and the sampling frequency on the bandwidth of the flat-topped PAM signal. **(2+10)**

SECTION – B

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

5. The maximum and the minimum values of the message signal, $m(t)$ = 10 cos(2000 πt) + 6cos(6000 πt) are 16 and −16, respectively. The message signal is sampled at 50% higher than the Nyquist rate, quantized with mid-rise type quantizer and then encoded to obtain PCM signal. **(5+15+15=35)**

Contd P/3

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Contd ... Q. No. 5

(i) Draw the amplitude spectrum of the sampled signal.

(ii) Determine the minimum number of quantization levels and the corresponding data rate to achieve the minimum signal to quantization noise ratio (SQNR) of 18 dB if a uniform quantizer is used. Also determine the data bits for time duration t = 0 to 0.5 ms if the first sample starts at t = 0.

(iii) Determine the data bits for time duration t = 0 to 0.5 ms if a non-uniform quantization is performed with μ-law(μ = 255) and the no. of levels is used as in (ii). Also determine the SQNR for this non-uniform quantization.

6. (a) Draw the block diagrams of DPCM transmitter and receiver. Show that the reconstruction error in DPCM is equal to the quantization error. **(17)**

(b) A message signal, m(t) = 4sin(2000 πt) + 2sin(6000 πt) is sampled at 300% higher than the Nyquest rate for Δ-modulation. **(18)**

(i) Determine the step size of the Δ-modulator to minimize the slope overloading error.

(ii) Determine the data rate of the Δ-modulated signal.

(iii) Determine the quantization noise and data bits for 6 samples if the first sample starts at t = 0.001 ms.

7. (a) Draw the block diagrams of BFSK modulator and (coherent) demodulator. Also write down the expressions of the signals at the input and output of each of the blocks of BFSK modulator and demodulator for data bits "1" and "0". **(17)**

(b) For the Q-PSK modulator shown in Fig. for Q. 7(b), **(18)**

(i) Plot the typical signals b(t), $a_1(t)$, $a_2(t)$, $c_1(t)$, $c_2(t)$ and S(t) for bit sequence "00101101".

(ii) Draw the constellation diagram of the modulator.

(iii) Draw the block diagram of Q-PSK demodulator and explain how the demodulator works for the modulated signal S(t).

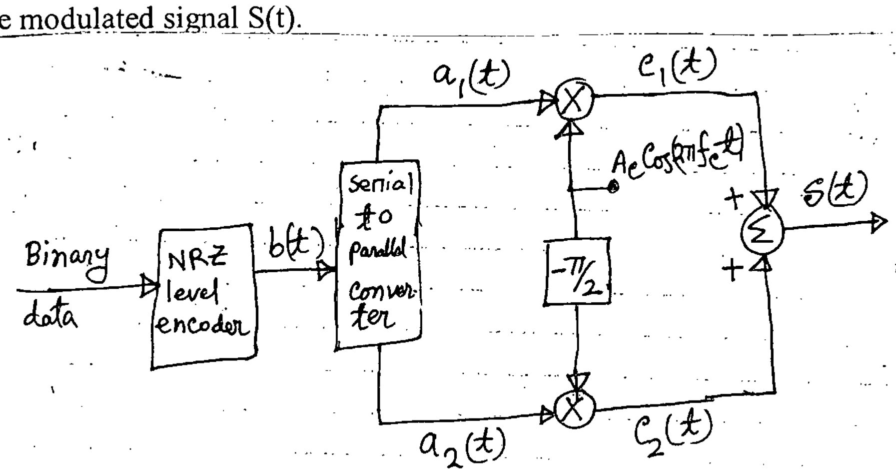

Fig. for Q. 7(b)

Contd P/4

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8. (a) Assume that currently the number of required telephone lines in BUET is 2000. The number of lines increases 50 per year. Design TDM Systems for BUET with 20 years plan using (i) T-carrier and (ii) E-carrier. **(12)**

(b) Write down the comparative advantages and disadvantages between random and channelization medium access protocols. **(5)**

(c) Consider the PN sequences for a 3-user DS-CDMA system are $C_1 = [1, -1, 1, -1, 1, -1, -1]$, $C_2 = [1, 1, -1, -1, 1, 1, -1]$, $C_3 = [-1, 1, -1, -1, 1, -1, 1]$, respectively. The data bit sequences for the users are b_1 = "10", b_2 = "01", and b_3 = "11", respectively. **(18)**

(i) Draw the transmitted baseband signal for each of the users.

(ii) Draw the received baseband signal with

(a) Zero interference

(b) Wideband interference, n = [0, 0, 0, 5, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,]

(c) Narrow band interference, n = [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5]

in the channel.

(iii) Draw the decoded baseband signal by the receiver of user 2 for each of the received signal in (ii).

(iv) Determine the output bit sequence at the receiver of user 2 for each of the received signals in (ii) and comment on the result.

Contd. . . . P/5

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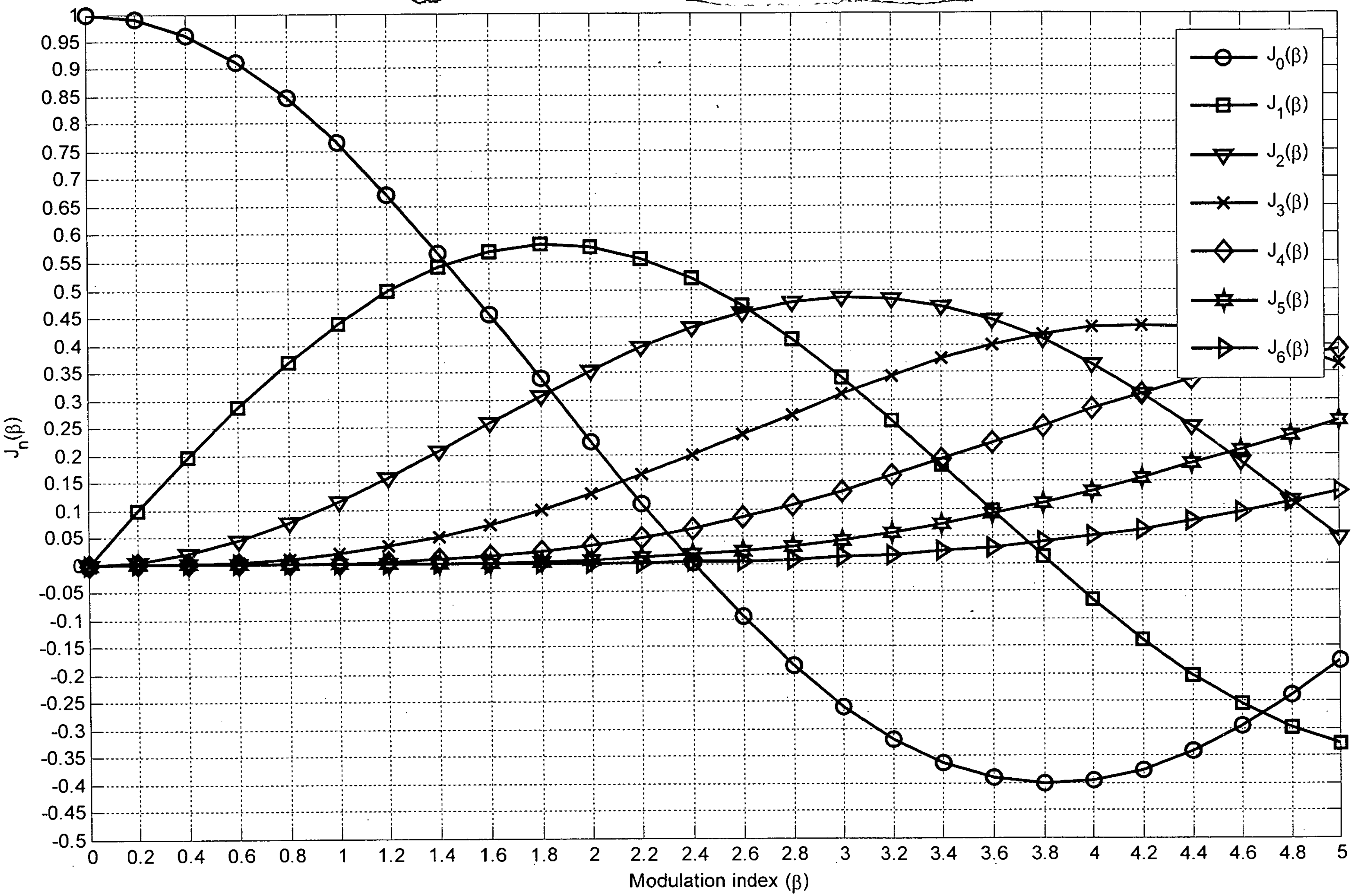

Fig. for Q. No. 3(b)

EEE 309

L-3/T-2/EEE Date : 23/07/2016

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **EEE 315** (Microprocessor and Interfacing)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Provide necessary comments in assembly language codes.

1. (a) The address 0010H:5000H contains an instruction. What should be the value of IP for a program to execute that instruction, if CS is OOOOH? What is the advantage of this overlapping nature of memory segments? **(8)**

   (b) Write a code snippet to copy the contents of the first two words in the stack without changing the stack pointer. **(7)**

   (c) What is the effect of XOR AX, AX instruction on the register AX? Why is it preferred over alternative ways of achieving the same result? **(7)**

   (d) Write an assembly language program to calculate the sum of first N Fibonacci numbers. You must calculate the N th Fibonacci number using a recursive procedure. **(13)**

2. (a) What is the difference between SHR and SAR instructions? Explain why such distinction is not required for SHL and SAL. **(8)**

   (b) For each of the following statements, state the addressing modes of the source and destination operands. **(10)**

   (i) MOV BX, 1000H
   (ii) MO ALPHA, AX ; where ALPHA is a word
   ; variable
   (iii) ADD AX, [BX]
   (iv) SUB CX, –2[BX]
   (v) MOV [BX] + ALPHA, CX

   (c) Write an assembly language program to calculate the median of an array of N words. Median is the middle value of a data set, after it is arranged in ascending or descending order. For even number of data, median is the mean of two middle values. **(17)**

3. (a) Write an assembly language program to count the number of times the string 'eee' is repeated in a longer lower case array. **(15)**

   (b) Find the values of status flags and all concerned registers after executing each of the following instruction sequentially. Assume that the initial contents of AL and BL are 80H and FFH respectively. **(12)**

   (i) NEG AL
   (ii) IMUL BL
   (iii) ADD AL, BL
   (iv) RCR AL, 1
   (v) INC BL

   (c) Write two alternate ways of executing an infinite loop in assembly language. **(8)**

Contd P/2

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4. (a) Design an 8086 based system with two 2k×8 RAMs and four 1k×8 ROMs. The RAMs are placed in the memory space from 1B800H to 1C3FFH and from 1DCOOH to 1DFFFH. The ROMs are placed from the starting address of 1E800H onwards. Implement even-odd banking. Show the memory map and connection schematic including address decoders. **(25)**

(b) What problems may arise if you replace the $\overline{\text{BHE}}$ signal in the above design with $\overline{\text{AO}}$? **(5)**

(c) Why is it important to latch the contents of address bus in an 8086 based system? **(5)**

SECTION – B

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

Assume reasonable data if necessary.

Provide necessary comments in assembly language codes.

5. (a) Consider an 8086 microprocessor based system in which a 4×3 keypad (figure for question No. 5(a)) is connected to the PORTA and PORTC, and a seven segment display is connected to the PORTB of an 8255A PPI with base address 28H. Design the schematic of the system so that it will take a BCD input from the keypad and display the BCD number to the seven segment display. Assume that each segment consumes 25 mA at 1.5 V. **(12)**

(b) 8086 microprocessor has the clock speed of 5 MHz. You have to write an assembly language code for the above mentioned system considering the following facts: **(23)**

(i) 8255A PPI has to be initialized as per the design requirements.

(ii) A delay of 20 ms has to be used to avoid debouncing of keypress.

(iii) It takes 50 ms to determine a BCD value from the keypad. So the seven segment has to be refreshed after every 50 ms.

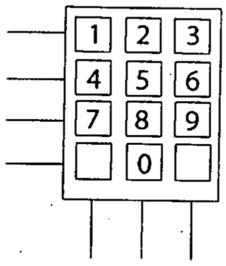


Figure for question No. 5 (a)

6. A freshman of BUET needs a pre-settable alarm system to attend his/her classes punctually. You have an 8254 timer (with base address 38 H) and an 8255 A PPI (with base address 29H) along with 8086 microprocessor to design the system for this freshman. The system will accept 4 digit BCD value in seconds to set the alarm through PORTA and PORTB of 8255 A. Each BCD digit requires four input lines, so PORTA and PORTB of 8255A will be sufficient to take the 4 digit BCD input. Connect the buzzer of the alarm to the PCO pin of 8255 A. An external clock of 10 kHz is available. Alarm should last for 4 seconds.
   (a) Design the schematic of the system and briefly explain your design. **(17)**
   (b) Write an assembly language code for your design. **(18)**

7. In an 8086 microprocessor based system two 8259A priority interrupt controller ICs are configured as master and slave. The INTR of slave is routed through IR7 of the master 8259A to the 8086. Let the slave is interrupted at IR5. The interrupt type of IR7 of master is 47 H and IR5 of the slave is 65H. The internal addresses of master are B8H and BAH while the internal addresses of slave are 138 H and 13A H.
   (a) Draw the schematic of the system with address decoding. **(15)**
   (b) Briefly describe how the master and slave devices work together in the cascaded configuration. **(8)**
   (c) Write assembly language codes to initialize both master and slave considering the following facts: **(12)**
      (i) Master and slave are both level triggered.
      (ii) Buffers are not used.

8. A microcomputer is connected to an 8251A USART (with base address FFOOH). A priority interrupt controller 8259A (with base address FOFOH) is also available for transmitting or receiving serial data. The input clock frequency for the USART is 614.4 kHz.
   (a) Draw the schematic of the system. **(8)**
   (b) A serial communication is to be established with baud rate of 9600 Bd, 8 bit character length, one stop bit, even parity, enabled error reset, disabled hunt mode and no break character. Construct the mode and command word that must be sent for the USART. **(8)**
   (c) Write assembly language codes for worst case initialization of 8251A so that it can be used either as transmitter or receiver. **(10)**
   (d) Write an interrupt service routine to transmit and receive the serial data using interrupt method. (You don't have to write the instructions to initialize 8259A). **(9)**

8255A PPI Mode Set Control Word:

D7	D6	D5	D4	D3	D2	D1	D0
Mode Set Flag	PORTA Mode		PORTA I/O	PORTC (U) I/O	PORTB Mode	PORTB I/O	PORTC (L) I/O

8254 Control Word:

D7	D6	D5	D4	D3	D2	D1	D0
SC1	SC0	RW1	RW0	M2	M1	M0	BCD

8259A Control Words:

	A0	D7	D6	D5	D4	D3	D2	D1	D0
ICW1	0	A7	A6	A5	1	LTIM	ADI	SNGL	IC4
ICW2	1	A15/T7	A14/T6	A13/T5	A12/T4	A11/T3	A10	A9	A8
ICW3 Master	1	S7	S6	S5	S4	S3	S2	S1	S0
ICW3 Slave	1	0	0	0	0	0	ID2	ID1	ID0
ICW4	1	0	0	0	SFNM	BUF	M/S	AEOI	µPM
OCW1	1	M7	M6	M5	M4	M3	M2	M1	M0
OCW2	0	R	SL	EOI	0	0	L2	L1	L0

8251A Mode Word:

D7	D6	D5	D4	D3	D2	D1	D0
S2	S1	EP	PEN	L2	L1	B2	B1

8251A Command Word:

D7	D6	D5	D4	D3	D2	D1	D0
EH	IR	RTS	ER	SBRK	RxE	DTR	TxEN

8251A Status Word:

D7	D6	D5	D4	D3	D2	D1	D0
DSR	SYNDET	FE	OE	PE	TxE	RxRDY	TxRDY

L-4/T-1/EEE **Date : 27/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **IPE 493** (Industrial Management)

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** questions.

1. (a) Write down different demand states with suitable examples. **(10)**

(b) Explain different patterns of target market selection. **(10)**

(c) What are the five forces that determine the long-run attractiveness of a market segment? Explain with suitable example. **(15)**

2. (a) What is top down budgeting? Mention its advantages and disadvantages. **(8)**

(b) Define leader and leadership. Explain why managers should be leaders. **(12)**

(c) What is technological life cycle? Explain why market growth is different at different stages of technological life cycle. **(15)**

3. (a) Venus Company produces toys and other items for use in beach and resort areas. A small, inflatable toy has come onto the market that the company is anxious to produce and sell. The new toy will for \$3 per unit. Enough capacity exists in the company's plant to produce 16,000 units of the toy each month. Variable costs to manufacture and sell one unit would be \$1.25, and fixed costs associated with the toy would total \$35,000 per month. The company's Marketing Department predicts that demand for the new toy will exceed the 16,000 units that the company is able to produce. Additional manufacturing space can be rented from another company at a fixed cost of \$1,000 per month. Variable costs in the rented facility would total \$1.40 per unit, due to somewhat les efficient operations than in the main plant. **(20)**

Required:

(i) Compute the monthly break-even point for the new toy in units and in total sales dollars. Show all computations in good form.

(ii) How many units must be sold each month to make a monthly profit of \$12,000?

(iii) If the sales manager receives a bonus of 10 cents for each unit sold in excess of the berak-even point, how many units must be sold each month to earn a return of 25% on the monthly investment in fixed costs?

(b) Windhoek Mines, Ltd., of Namibia, is contemplating the purchase of equipment to exploit a mineral deposit on land to which the company has mineral rights. An engineering and cost analysis has been made,

Contd P/2

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

and it is expected that the following cash flows would be associated with opening and operating a mine in the area:

Cost of new equipment and timbers	R 282,950
Working capital required	R 100,000
Net annual cash receipts	R 120,000
Cost to construct new roads in three years	R 40,000
Salvage value of equipment in four years	R 65,000

The currency in Namibia is the rand, denoted here by R. It is estimated that the mineral deposit would be exhausted after four years mining. At that point, the working capital would be released for reinvestment elsewhere. The company's required rate of return is 20%. **(15)**

Required:

(i) Determine the net present value of the proposed mining project. Should the project be accepted? Justify your choice.

4. (a) What are the essential skills of a manager? **(7)**

(b) What are the contributions of Frank and Lillian Gilbreth in the field of management? How does today's manager use them? **(8)**

(c) As part of a major plant renovation project, the industrial engineering department has been asked to balance a revised assembly operation to achieve an output of 240 units per eight-hour day. Task times and procedure relationships are as follows: **(20)**

Task	Duration (minutes)	Immediate Predecessor
a	0.2	-
b	0.4	a
c	0.2	b
d	0.4	-
e	1.2	d
f	1.2	c
g	1.0	e, f

Do each of the following:

(i) Draw the precedence diagram.

(ii) Determine the minimum cycle time, maximum cycle time, and the calculated cycle time.

(iii) Determine the minimum number of stations needed.

(iv) Assign tasks to workstations on the basis of greatest number of following tasks. Use longest processing time as a tiebreaker. If ties still exist, assume indifference in choice.

(v) Compute the percentage of idle time for the assignment in part ***d***.

IPE 493

SECTION – B

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

5. (a) Discuss Matrix type organizations with necessary examples. What are its advantages and disadvantages? **(15)**

   (b) One unit of A is made of two units of B and one unit of C. B is made of three units of D and one unit of F. C is composed of three units of B, one unit of D, and four units of E. D is made of one unit E and one unit F. Item C has a lead time of one week . Items A, B, E and F each have a two-week lead time and Item D has lead time of three weeks. The amount of on-hand inventories for items A, B, D, and E are 5, 10, 60 and 50 respectively. All other items have zero beginning inventories. We are scheduled to receive 10 units of A in Week 3, 20 units of B in Week 7, 40 units of F in Week 5, and 60 units of E in Week 2. There are no other scheduled receipts. If 20 units of A are required in Week 10, then **(20)**

   (i) Show the product structure tree.

   (ii) Develop an MRP planning schedule showing gross requirement, net requirement, order release and order receipt dates.

6. (a) Discuss ERG theory of motivation. What are the differences between ERG theory and Maslow's need theory? **(10)**

   (b) Discuss different types of formal teams with necessary examples. **(10)**

   (c) A particular raw material is available to a company at three different prices, depending on the size of the order: **(15)**

Less than 100 pounds	$20 per pound
100 pounds to 1,000 pounds	$19 per pound
More than 1,000 pounds	$18 per pound

   The cost of placing an order is $40. Annual demand is 3,000 units. Holding (or carrying) cost is 25 percent of the martial price. What is the economic order quantity to buy each time?

7. (a) Discuss different types of cost of quality. **(20)**

   (b) Seven jobs must be processed in two machines – A and B. All seven jobs must go through first A, then B – in that order. Using the processing times given below, determine the **optimal order** in which the jobs should be sequenced through the two machines. Also draw the **optimum schedule** with time indication and calculate **total processing time** and **total idle time** from that schedule. **(15)**

Contd P/4

IPE 493

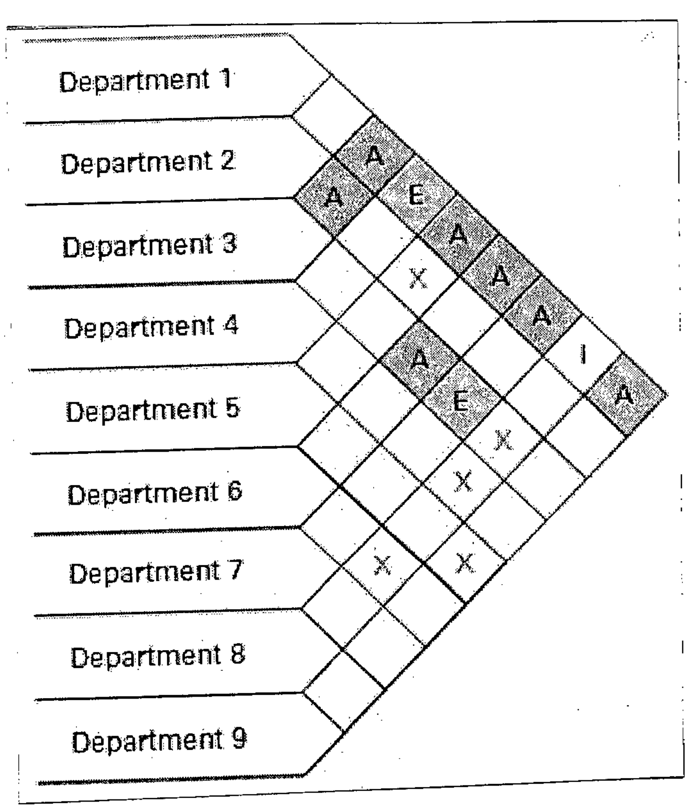
Contd ... Q. No. 7(b)

Job	Process A	Process B
1	9	6
2	8	5
3	7	7
4	6	3
5	1	2
6	2	6
7	4	7

8. (a) What is leadership? Which traits must be present in a leader, according to trait theory? **(2+8)**

(b) What are the assumptions of Fiedler's model? Explain Hersey and Blanchard's Situational Leadership Theory? **(3+7)**

(c) Assign nine automobile service departments to bays in a 3-3 grid so that the closeness ratings in the following matrix are satisfied. The location of department 4 must be in the bottom right-hand corner of the grid to satisfy a town ordinance. **(15)**



For Q. 8(c)

Periods	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%
1	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.826	0.820
2	0.925	0.907	0.890	0.873	0.857	0.842	0.826	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694	0.683	0.672
3	0.889	0.864	0.840	0.816	0.794	0.772	0.751	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579	0.564	0.551
4	0.855	0.823	0.792	0.763	0.735	0.708	0.683	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482	0.467	0.451
5	0.822	0.784	0.747	0.713	0.681	0.650	0.621	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402	0.386	0.370
6	0.790	0.746	0.705	0.666	0.630	0.596	0.564	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335	0.319	0.303
7	0.760	0.711	0.665	0.623	0.583	0.547	0.513	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279	0.263	0.249
8	0.731	0.677	0.627	0.582	0.540	0.502	0.467	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233	0.218	0.204
9	0.703	0.645	0.592	0.544	0.500	0.460	0.424	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194	0.180	0.167
10	0.676	0.614	0.558	0.508	0.463	0.422	0.386	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162	0.149	0.137
11	0.650	0.585	0.527	0.475	0.429	0.388	0.350	0.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135	0.123	0.112
12	0.625	0.557	0.497	0.444	0.397	0.356	0.319	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112	0.102	0.092
13	0.601	0.530	0.469	0.415	0.368	0.326	0.290	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093	0.084	0.075
14	0.577	0.505	0.442	0.388	0.340	0.299	0.263	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078	0.069	0.062
15	0.555	0.481	0.417	0.362	0.315	0.275	0.239	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065	0.057	0.051
16	0.534	0.458	0.394	0.339	0.292	0.252	0.218	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054	0.047	0.042
17	0.513	0.436	0.371	0.317	0.270	0.231	0.198	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045	0.039	0.034
18	0.494	0.416	0.350	0.296	0.250	0.212	0.180	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038	0.032	0.028
19	0.475	0.396	0.331	0.277	0.232	0.194	0.164	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031	0.027	0.023
20	0.456	0.377	0.312	0.258	0.215	0.178	0.149	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026	0.022	0.019
21	0.439	0.359	0.294	0.242	0.199	0.164	0.135	0.112	0.093	0.077	0.064	0.053	0.044	0.037	0.031	0.026	0.022	0.018	0.015
22	0.422	0.342	0.278	0.226	0.184	0.150	0.123	0.101	0.083	0.068	0.056	0.046	0.038	0.032	0.026	0.022	0.018	0.015	0.013
23	0.406	0.326	0.262	0.211	0.170	0.138	0.112	0.091	0.074	0.060	0.049	0.040	0.033	0.027	0.022	0.018	0.015	0.012	0.010
24	0.390	0.310	0.247	0.197	0.158	0.126	0.102	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.015	0.013	0.010	0.008
25	0.375	0.295	0.233	0.184	0.146	0.116	0.092	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.013	0.010	0.009	0.007

Table 1: Present Value of $1

Periods	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%
1	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833	0.826	0.820
2	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528	1.509	1.492
3	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106	2.074	2.042
4	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589	2.540	2.494
5	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991	2.926	2.864
6	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326	3.245	3.167
7	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605	3.508	3.416
8	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837	3.726	3.619
9	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031	3.905	3.786
10	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192	4.054	3.923
11	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327	4.177	4.035
12	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439	4.278	4.127
13	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533	4.362	4.203
14	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611	4.432	4.265
15	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675	4.489	4.315
16	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730	4.536	4.357
17	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775	4.576	4.391
18	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812	4.608	4.419
19	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843	4.635	4.442
20	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870	4.657	4.460
21	14.029	12.821	11.764	10.836	10.017	9.292	8.649	8.075	7.562	7.102	6.687	6.312	5.973	5.665	5.384	5.127	4.891	4.675	4.476
22	14.451	13.163	12.042	11.061	10.201	9.442	8.772	8.176	7.645	7.170	6.743	6.359	6.011	5.696	5.410	5.149	4.909	4.690	4.488
23	14.857	13.489	12.303	11.272	10.371	9.580	8.883	8.266	7.718	7.230	6.792	6.399	6.044	5.723	5.432	5.167	4.925	4.703	4.499
24	15.247	13.799	12.550	11.469	10.529	9.707	8.985	8.348	7.784	7.283	6.835	6.434	6.073	5.746	5.451	5.182	4.937	4.713	4.507
25	15.622	14.094	12.783	11.654	10.675	9.823	9.077	8.422	7.843	7.330	6.873	6.464	6.097	5.766	5.467	5.195	4.948	4.721	4.514

Table 1: Present Value of an Annuity of $1 in Arrears

L-3/T-2/EEE **Date : 01/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2014-2015

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** questions.

1. (a) A causal linear time-invariant system is described by the difference equation **(15)**

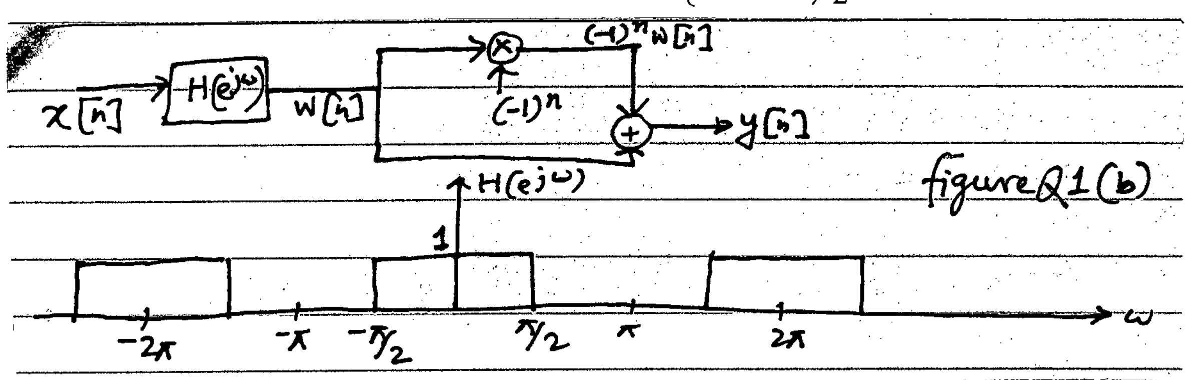
$$y[n]-5y[n-1]+6y[n-2]=2x[n-1]$$

(i) Determine the homogenous response of the system.

(ii) Determine the impulse response of the system.

(iii) Determine the step response of the system.

(b) For the system in Figure Q. No. 1(b), determine the output $y[n]$ when the input $x[n]$ is $\delta[n]$ and $H(e^{j\omega})$ is an ideal low pass filter, $H(e^{j\omega})=\begin{cases}1 & , \quad |\omega|<\pi/2\\ 0 & , \quad \pi/2<|\omega|\le\pi\end{cases}$ **(20)**



2. (a) A linear time-invariant (LTI) system is described by the input-output relation $y[n]=x[n]+2x[n-1]+x[n-2]$. **(18)**

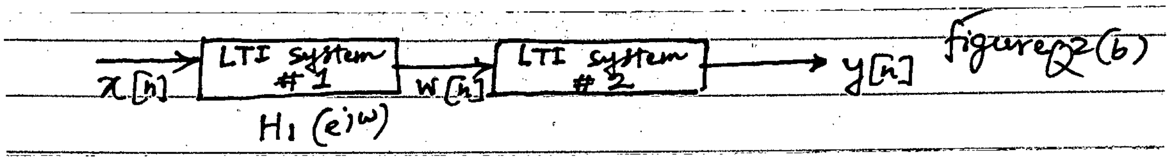
(i) Is this a stable system?

(ii) Determine Frequency response of the system, $H(e^{j\omega})$.

(iii) Plot the magnitude and phase of the frequency response.

(iv) Consider a new system, $H_1(e^{j\omega})=H(e^{j(\omega+\pi)})$. Determine $h[n]$.

(b) Consider the cascade of LTI discrete – time system shown in Figure Q. No. 2(b). **(17)**



The first system, $H_1(e^{j\omega})=\begin{cases}1 & , \quad |\omega|<0.5\pi\\ 0 & , \quad 0.5\pi\le|\omega|<\pi\end{cases}$.

The second system; $y[n]=w[n]-w[n-1]$

The input to the system is $x[n]=cos(0.6\pi n)+3\delta[n-5]+2$

Determine the output $y[n]$ and $Y(e^{j\omega})$.

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3. (a) The input to an LTI system is $x[n]=\left(\frac{1}{2}\right)^n u[n]+2^n u[-n-1]$.

The output is, $y[n]=6\left(\frac{1}{2}\right)^n u[n]-6\left(\frac{3}{4}\right)^n u[n]$ **(20)**

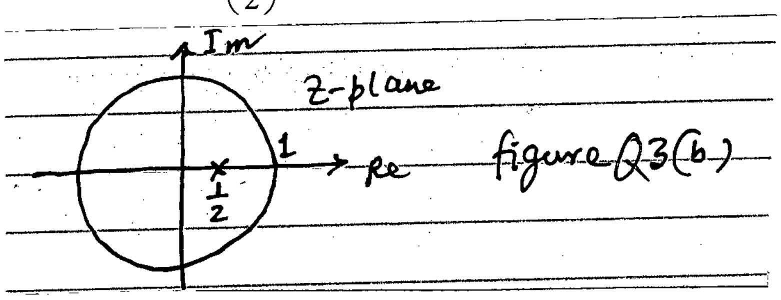
(i) Find the system function $H(z)$ of the system. Plot the poles and zeros of $H(z)$ and indicate the Region of convergence.

(ii) Find the impulse response $h[n]$ of the system.

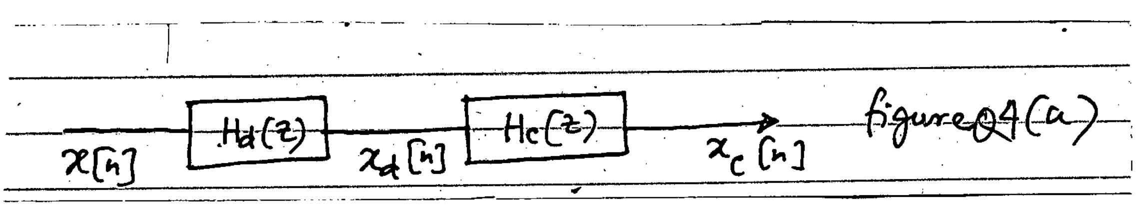
(iii) Write the difference equation that characterizes the system.

(iv) Is the system stable? Is it causal?

(b) let $x[n]$ be the sequence with the pole-zero plot shown in Figure Q. No. 3(b). Sketch the pole-zero plot for, $y[n]=\left(\frac{1}{2}\right)^n x[n]$. Specify the region of convergence of $Y(z)$. **(15)**



4. (a)

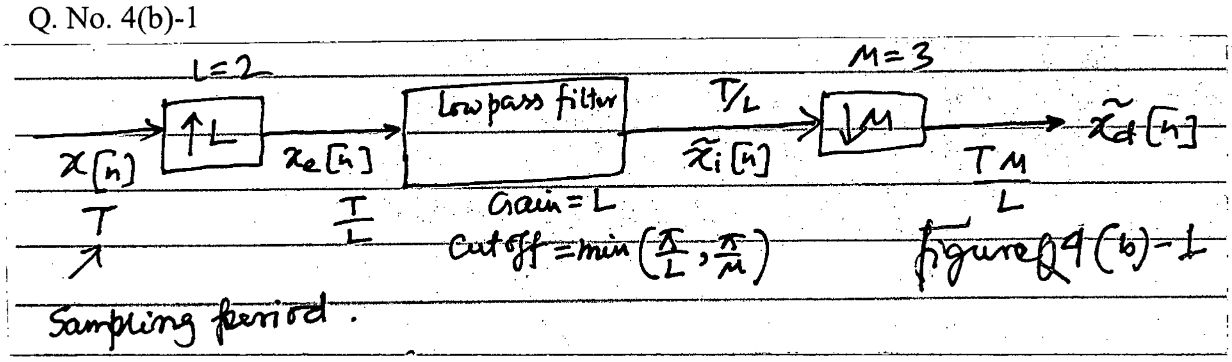


For the system in Figure Q. No. 4(a), given that $H_d(z)$ is causal, stable and non- minimum phase, given by

$$H_d(z)=\frac{2\left(1-z^{-1}\right)\left(1+0.5z^{-1}\right)}{\left(1-0.8e^{j\pi/4}z^{-1}\right)\left(1-0.8e^{-j\pi/4}z^{-1}\right)}$$

Choose $H_c(z)$ so that it is stable, causal and the magnitude of overall effective frequency response is unity. **(15)**

(b) The system for changing the sampling rate by a non-integer factor is given by Figure Q. No. 4(b)-1 **(20)**



L = up sampling factor = 2. M = down sampling factor = 3

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Contd … Q. No. 4(b)

Sketch

(i) $\left|X\left(e^{j\omega}\right)\right|$

(ii) $\left|X_e\left(e^{j\omega}\right)\right|$

(iii) $\left|\tilde{X}_i\left(e^{j\omega}\right)\right|$

(iv) $\left|\tilde{X}_d\left(e^{j\omega}\right)\right|$

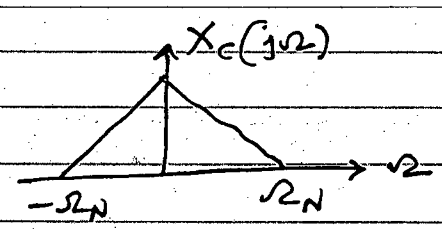

figure Q4(b)-2

Where, x[n] is obtained from $x_C(t)$, $x_C(j\Omega)$ is given in Figure Q. No. 4(b)-2.

SECTION – B

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

Symbols have their usual meanings.

5. (a) What are the two main problems in designing ideal low pass filter? Briefly describe the principle of Windowing method of FIR filter design. **(10)**

(b) What is the limitation of the impulse invariance method of IIR filter design? How the principle used in the bilinear transfer method can overcome the limitation? **(10)**

(c) Fig for Q. No. 5(c) shows the signal flow graph for a causal discrete time LTI system **(15)**

(i) Find $H(z)=\dfrac{Y(z)}{X(z)}$.

(ii) Determine $h[1]$, the impulse response at $n = 1$.

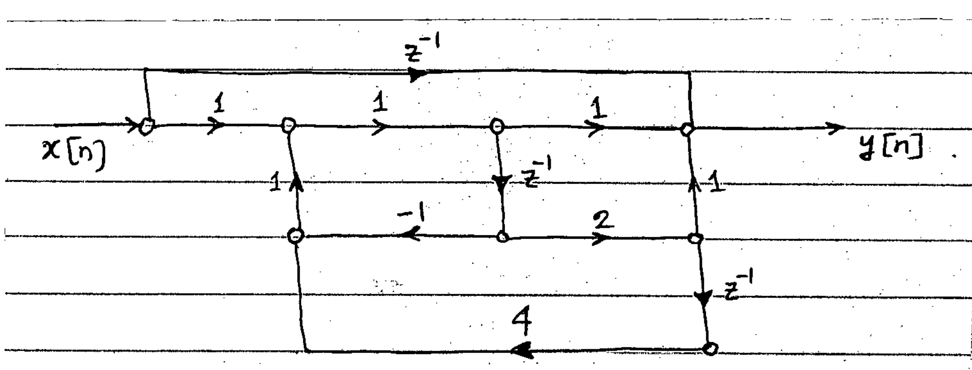

Fig. for Q. No. 5(c)

6. (a) Consider a finite-length sequence x[n] of length N. Two finite-length sequences $x_1[n]$ and $x_2[n]$ of length 2N are constructed from x[n]. In Fig. for Q. No. 6(a), x[n]. $x_1[n]$ and $x_2[n]$ are shown (solid line is used to suggest the envelope of the sequence values. The N-point DFT of x[n] is denote by X[k] and the 2N point DFTs of $x_1[n]$ and $x_2[n]$ are denoted by $X_1[k]$ and $X_2[k]$, respectively. **(15)**

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

(i) Specify how $X_2[k]$ can be obtained if $X[k]$ is given.

(ii) Show that $X[k]$ can be obtained by decimating $X_1[k]$ by 2.

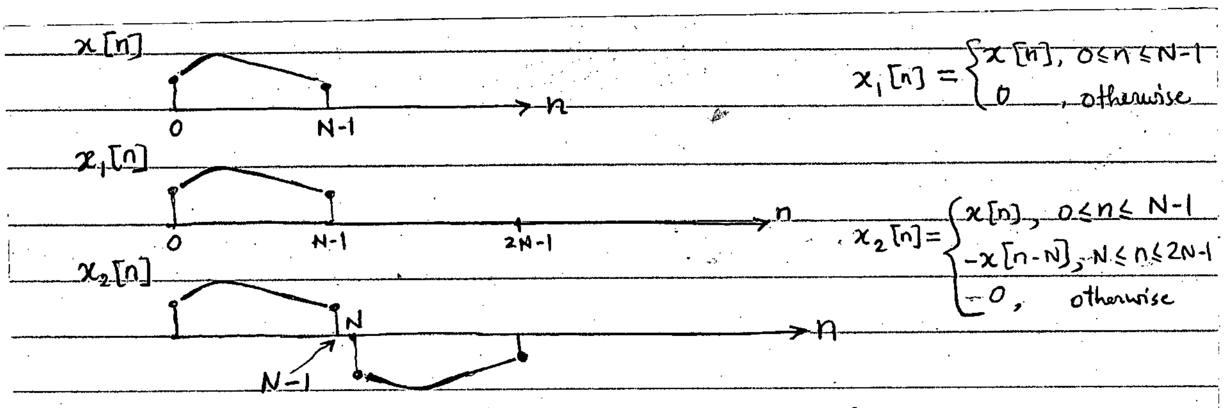

Fig. for Q. No. 6(a)

(b) Given that $x_1[n] = [\,1\ 0\ \ 1\ \ 2\,]$ **(20)**

$\uparrow$

$x_2[n] = [\,1\ 0\ \ 1\,]$

$\uparrow$

$y_1[n] = x_1[((n-2))_4]$, $\quad y_2[n] = x_2[((n+1))_4]$,

(i) Find $Y_1[k]$ and $Y_2[k]$.

(ii) If $y_c[n] = y_1[n]$ ④ $y_2[n]$, find $Y_c[k]$ and using $Y_c[k]$ find $y_c[n]$.

7. (a) For the system shown in Fig. for Q. No. 7(a), for the basic filter block $H(e^{j\omega})$ it is given that

$$h[n] = \begin{cases} h[-n] \ , & -L \le n \le L \\ 0 \ , & \text{otherwise} \end{cases}$$

$H(e^{j\omega})$ satisfies the following approximation error specification: **(15)**

$$(1-\delta_1) \le \left|H(e^{j\omega})\right| \le (1+\delta_1)\ , \quad 0 \le \omega \le \omega_p$$

$$-\delta_2 \le \left|H(e^{j\omega})\right| \le \delta_2\ , \quad \omega_s \le \omega \le \pi$$

(i) Determine whether the overall impulse response $g[n]$ is FIR and symmetric.

(ii) Find the approximation error specification for $G(e^{j\omega})$.

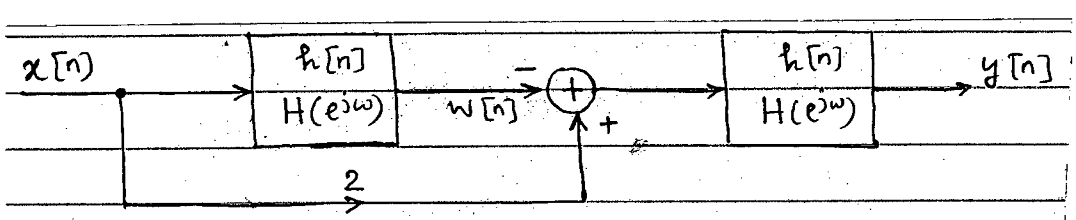

Fig. for Q. No. 7(a)

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Contd ... Q. No. 7

(b) By using Kaiser Window method design Type-I FIR filter with generalized linear phase that meets the following specifications: **(20)**

$$0.9 < \left|H\left(e^{j\omega}\right)\right| < 1.1, \quad 0 \le |\omega| \le 0.2\pi$$
$$-0.06 < \left|H\left(e^{j\omega}\right)\right| < 0.06, \quad 0.3\pi \le |\omega| \le 0.475\pi$$
$$1.9 < \left|H\left(e^{j\omega}\right)\right| < 2.1, \quad 0.525\pi \le |\omega| \le \pi$$

(i) Determine appropriate values of ripple δ, β $\Delta\omega$ and filter length.

(ii) Find $h_d[n]$ and $h[n]$.

8. (a) The system function of a discrete-time system is

$$H(z) = \frac{3}{1 - e^{-0.3} z^{-1}} - \frac{4}{1 - e^{-0.24} z^{-1}}$$

Assume that this discrete-time filter was designed by the impulse-invariance method with $h[n] = 3h_c(3n)$, where $h_c(t)$ is real. Find the system function $H_c(s)$ of a continuous time filter that could have been the basis for the design. Is your answer unique? **(10)**

(b) Consider designing a discrete-time filter with system function $H(z)$ from a continuous time filter with rational system function $H_c(s)$ by the transformation

$$H(z) = H_c(s)\Big|_{s=\frac{1-z^{-2}}{1+z^{-2}}}$$

(i) Show that the $j\,\Omega$ axis of the s-plane is mapped to the unit circle of z-plane.

(ii) Find the mapping between Ω and ω.

(iii) Consider the following specifications for the desired discrete-time filter

$$0.8 \le \left|H\left(e^{j\omega}\right)\right| \le 1, \quad 0 \le |\omega| \le 0.25\pi$$
$$\left|H\left(e^{j\omega}\right)\right| \le 0.15, \quad 0.4\pi|\pi| \le \pi$$

using the transformation specified at the beginning find $H(z)$. **(25)**
