S J P N Trust's

Hirasugar Institute of Technology, Nidasoshi.

Inculcating Values, Promoting Prosperity

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ECE Dept.
Exam.
Internal Assessment
Even Sem(2017-18)

SECOND INTERNAL ASSESSMENT

Sem: VI
Date: 11/04/2018

Sub:Digital Communication
Time: 11:00am-12:00pm

Sub. Code: 15EC61
Max. Marks:25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO	RBT LEVEL
1	a	Explain with block diagram QPSK transmitter and Reciever.	6	C301.3	L1,L2,L3
	b	Obtain the expression for average probability of error calculation for FSK with coherent receiver.	7	C301.3	L1,L2,L3
		OR			
2	a	Explain Gram Schmidt Orthogonalization procedure.	6	C301.2	L1,L2,L3
	b	Consider the set of signals $S_i(t)=\{ \sqrt{2E/T}\cos(2\pi f_c t - i\pi/4)$; $0 \le T \le t$ 0 ; elsewhere where i=0,1,2,3 and f_c is an integer multiple of 1/T. i)Determine a set of orthogonality N of the signal set. ii)Determine the coefficients S_{ij} of the signals $S_i(t)$.	7	C301.2	L1,L2,L3
3	a	Explain Non coherent DPSK System.	6	C301.3	L1,L2,L3
	b	Illustrate the operation of DPSK for the binary sequence 10010011 and find the encoded and decoded sequence.	6	C301.3	L1,L2,L3
		OR			
4	a	Explain the geometric representation of signals.	6	C301.2	L1,L2,L3
	b	Three signals $s_1(t)$, $s_2(t)$ and $s_3(t)$ are given as follows.Apply the Gram Schmidt procedure to obtain an orthonormal basis for the signals. $s_1(t)=3$; $0<t<4$ $s_2(t)=3$; $0<t<2$ $s_3(t)=3$; $2<t<4$	6	C301.2	L1,L2,L3

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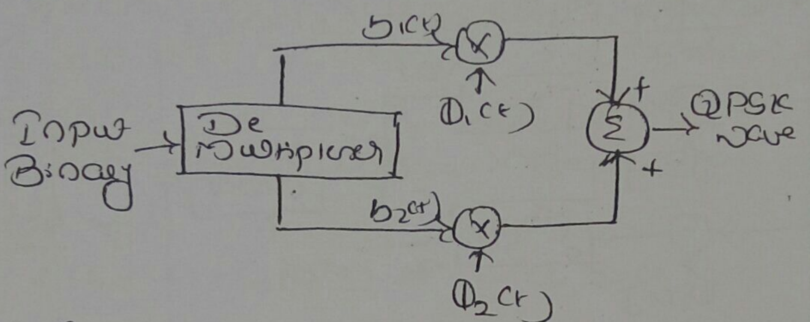
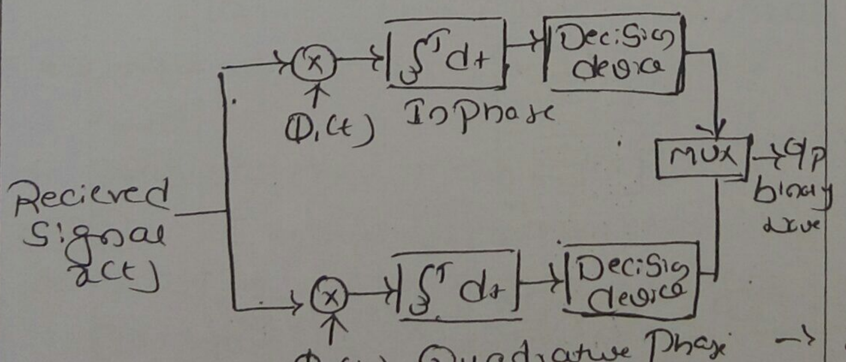
SCHEME OF EVALUATION IA- II

Sem : VI		Subject : Digital Communication	Sub Code : 15EC61	Date : 11/04/2018	
Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
1)	a)	**QPSK Transmitter :-**  * To split dibit demultiplexer will be used. $b_1(t)$ is odd & $b_2(t)$ is even. * Here $\phi_1(t) = \sqrt{\frac{2}{T}} \cos 2\pi f_c t$ → $\phi_2(t) = \sqrt{\frac{2}{T}} \sin 2\pi f_c t$	3M	C301.3	L1, L2, L3
		QPSK Reciever :-  If $x_1 > \lambda$ → Decision is in favour of '1' If $x_1 < \lambda$ → Decision is in favour of '0' If $x_2 > \lambda$ → Decision is in favour of '1' If $x_2 < \lambda$ → Decision is in favour of '0' * Two O/Ps of combined in multiplexer & reproduce original signal	3M		

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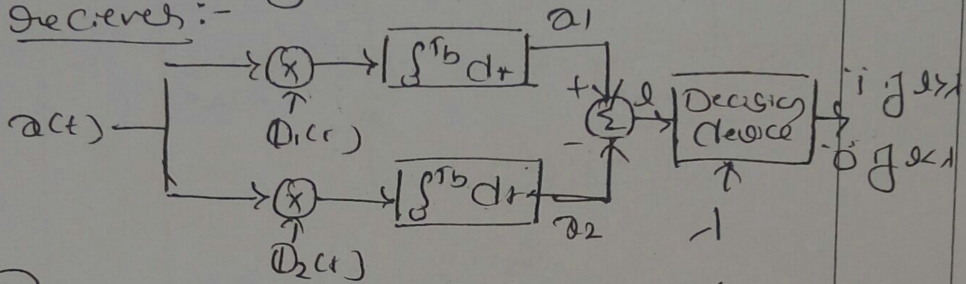
SCHEME OF EVALUATION IA-

Sem : VI	Subject : DC		Sub Code : 15EC61	Date : 11/04/2018		
Q. No.	**Bit**	**Description**		**Marks**	**CO's**	**RBT LEVEL**
1-)	b)	Average Probability of error calculation for FSK with Coherent receiver :-  Received signal is $x(t) = s(t) + w(t)$ $E(l) = E[x_1] - E[x_2] = 0 - \sqrt{E_b} = -\sqrt{E_b}$ $Var(l) = Var(x_1) + Var(x_2) = N_0$ $\|\|^{ly}$ $f_l(l\|0) = \frac{1}{\sqrt{2\pi N_0}} e^{-\left[\frac{l+\sqrt{E_b}}{\sqrt{2N_0}}\right]^2}$ ∴ By using above conditional pdf we can calculate $P_e(0)$ ∴ $P_e(0) = \frac{1}{2} erfc\left[\sqrt{\frac{E_b}{2N_0}}\right]$ $\|\|^{ly}$ $P_e(1) = \frac{1}{2} erfc\left[\sqrt{\frac{E_b}{2N_0}}\right]$ ∴ $P_e = P(0)P_e(0) + P(1)P_e(1)$ $P_e = \frac{1}{2}\left[\frac{1}{2} erfc\left[\sqrt{\frac{E_b}{2N_0}}\right] + \frac{1}{2} erfc\left[\sqrt{\frac{E_b}{2N_0}}\right]\right]$ $\boxed{P_e = \frac{1}{2} erfc\left(\sqrt{\frac{E_b}{2N_0}}\right)}$		3M 3M 1M	C301.3	L1, L2, L3

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SCHEME OF EVALUATION IA- II

Sem : VI | Subject : DC | Sub Code : 15EC61 | Date : 11/04/2018

Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
2)	a)	Gram Schmidth Orthogonalization Procedure consists of two steps. Step 1 :- We need check given set of the signals are independent or not i.e $a_1 s_1(t) + a_2 s_2(t) + \cdots + a_m s_m(t) = 0$ $\therefore a_m \neq 0$ $g_m(t) = -\left[\frac{a_1}{a_m} s_1(t) + \frac{a_2}{a_m} s_2(t) + \cdots \frac{a_{m-1}}{a_m} s_{m-1}(t)\right]$ Again we need to check the above equation is independent or not if not, there exist $b_1, b_2 \cdots b_{m-1}$ constants. →	2M		
		$\therefore s_{m-1} = -\left[\frac{b_1}{b_{m-1}} s_1(t) + \frac{b_2}{b_{m-1}} s_2(t) + \cdots + \frac{b_{m-2}}{b_{m-1}} s_{m-2}(t)\right]$ continuing in this way finally we need to conclude that set of the signals are linearly independent.		C301.2	L1, L2, L3
		Step 2 :- Orthonormal basis functions are having unit energy & they are orthogonal to each other i.e $\phi_i(t) = \frac{g_i(t)}{\sqrt{\int_0^T g_i^2(t)\,dt}}$ →	4M		
		$g_i(t) = s_i(t) - \sum_{j=1}^{i-1} s_{ij}\,\phi_j(t)$ $j = 1, 2 \cdots i-1$			

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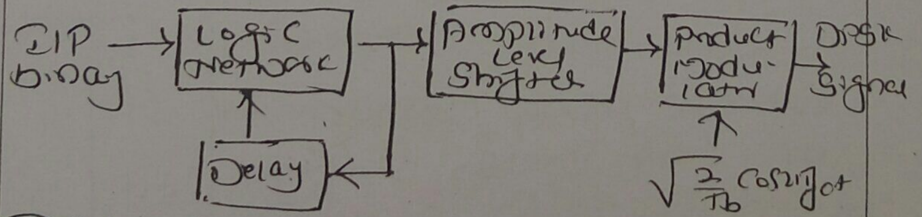
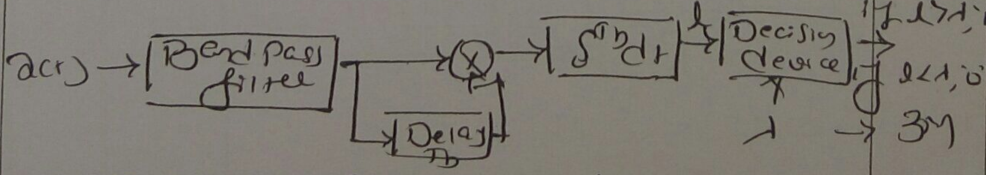
SCHEME OF EVALUATION IA-

Sem : VI | Subject : DC | Sub Code : 15EC61 | Date : 11/04/2018

Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
2)	b)	$S_i(t) = \sqrt{\frac{2E}{T}}\cos(2\pi f_c t - i\pi/4)$			
		$S_0(t) = \sqrt{\frac{2E}{T}}\cos 2\pi f_c t$			
		$S_1(t) = \sqrt{\frac{2E}{T}}\left[\frac{1}{\sqrt{2}}\cos 2\pi f_c t + \frac{1}{\sqrt{2}}\sin 2\pi f_c t\right]$			
		$S_2(t) = \sqrt{\frac{2E}{T}}\sin 2\pi f_c t$			
		$S_3(t) = \sqrt{\frac{2E}{T}}\left[-\frac{1}{\sqrt{2}}\cos 2\pi f_c t + \frac{1}{\sqrt{2}}\sin 2\pi f_c t\right]$			
		i) $\phi_1(t) = \sqrt{\frac{2}{T}}\cos 2\pi f_c t$; $\phi_2(t) = \sqrt{\frac{2}{T}}\sin 2\pi f_c t$ →	2M	C301.2	L1, L2, L3
		ii) $S_0 = (\sqrt{E}, 0)$ (S_{01}, S_{02}) ~~S_2 ($\sqrt{E/2}$, $\sqrt{E/2}$) (S_{21}, S_{22})~~			
		$S_1 = (\sqrt{E/2}, \sqrt{E/2})$ (S_{11}, S_{12}) $S_2 = (0, \sqrt{E})$ (S_{21}, S_{22})			
		$S_3 = (-\sqrt{E/2}, \sqrt{E/2})$ (S_{31}, S_{32}) →	5M		
3)	a)	DPSK Transmitter :- 			
		DPSK Receiver :-  →	3M	C301.3	L1, L2, L3
		Explanation of above block diagrams →	3M		

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SCHEME OF EVALUATION IA-

Sem : VI		Subject : DC	Sub Code : 15EC61	Date : 11/04/2018		
Q. No.	**Bit**	**Description**		**Marks**	**CO's**	**RBT LEVEL**

3) b) Binary sequence

1 0 0 1 0 0 1 1

0 0 1 0 0 1 0 0 0 → 3M

0 0 1 0 0 1 0 0 1 1 → 3M

C301.3 L1, L2, L3

∴ Encoded sequence is

0, 0, 1, 0, 0, 1, 0, 0, 0

∴ Decoded sequence is

1, 0, 0, 1, 0, 0, 1, 1

4) a) Geometric Representation of signals

Let m be the energy signals

$S_i(t) = \{ S_1(t), S_2(t) --- S_m(t) \}$

& $\Phi_j(t) = \{ \Phi_1(t), \Phi_2(t) --- \Phi_N(t) \}$

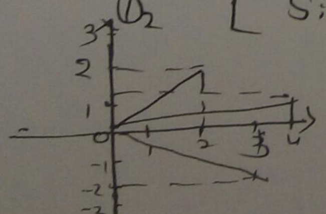
$\therefore S_i(t) = S_{i1}\Phi_1 + S_{i2}\Phi_2 + --- + S_{iN}\Phi_N(t)$

$= \sum_{j=1}^{N} S_{ij} \Phi_j(t)$

C301.2 L1, L2, L3

where $S_{ij} = \int^{T} S_i(t)\, \Phi_j(t)\, dt$ → 4M

$S_i = \begin{bmatrix} S_{i1} \\ S_{i2} \\ \vdots \\ S_{iN} \end{bmatrix}$ $i = 1, 2 -- m$ → 2M



This is example of signal space of N=2 & M=3

SCHEME OF EVALUATION IA-

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Q. No.	Bit	Description	Marks	CO's	RBT LEVEL
4)	b)	$s_1(t) = 3;\ 0 \le t \le 4$ $s_2(t) = 3;\ 0 \le t \le 2$ $s_3(t) = 3;\ 2 \le t \le 4.$ $\therefore E_1 = \int_0^T s_1^2(t)\,dt = 36$ $\therefore \phi_1(t) = \frac{s_1(t)}{\sqrt{E}} = \frac{3}{\sqrt{36}} = \frac{3}{6} = \frac{1}{2}.$ $\therefore \phi_1(t) = \begin{cases} \frac{1}{2} & 0 \le t \le 4 \\ 0 & \text{elsewhere.} \end{cases} \rightarrow$	2M		
		WKT $s_{21} = \int_0^T s_2(t)\,\phi_1(t)\,dt.$ $s_{21} = \int_0^2 3 \times \frac{1}{2} = \frac{3}{2} \times 2 = 3$ $\boxed{s_{21} = 3}$ $g_2(t) = s_2(t) - s_{21}\phi_1(t)$ $\int_0^T g_2^2(t) = \int_0^T [s_2(t) - 3\phi_1(t)]^2 dt$ $= 9 \times 2 + 9 \times \frac{1}{4} \times 4 - 2 \times 3 \times 3 \times \frac{1}{2} \times 2$ $= 18 + 9 - 18 = 9.$ $\therefore \sqrt{\int_0^T g_2^2(t)\,dt} = 3$ $\therefore \phi_2(t) = \frac{1}{3}[s_2(t) - 3\phi_1(t)]$ $\therefore \phi_2(t) = \begin{cases} \frac{1}{2}, & 0 \le t \le 2 \\ -1/2 & 2 \le t \le 4 \\ 0 & \text{Otherwise} \end{cases} \rightarrow$	4M	C301.2	L1, L2, L3