

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2018

B. Tech in Electronics & Communication Engineering, Semester - VI

Roll No.....

ECE602: DIGITAL COMMUNICATION

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A	Objective type multiple choice questions (10 questions @ 1 mark)	10
i.	Two signals ϕ_1 & ϕ_2 will be orthonormal to each other if (a) ϕ_1 & ϕ_2 are orthogonal (b) both ϕ_1 & ϕ_2 are of unit energy (c) if both a & b are true (d) if both ϕ_1 & ϕ_2 are linearly independent	
ii.	The balance property of a maximal length sequence is stated to be satisfied if (a) nos. of 1s equals nos. of 0s (b) No. of 1s is exceeds no. of 0s by one (c) nos. of 1s is less than the nos. of 0s (d) none of the above	
iii.	In binary data transmission DPSK is preferred to PSK because (a) a coherent carrier is not required to be generated at the receiver (b) for a given energy per bit, the probability of error is less (c) the 180° phase shifts of the carrier are unimportant (d) more protection is provided against impulse noise	
iv.	For a bit-rate of 8 kbps, the best possible values of the transmitted frequencies in a coherent binary FSK system are (a) 16 KHz and 20 KHz (b) 20 KHz and 32 KHz (c) 20 KHz and 40 KHz (d) 32 KHz and 40 KHz	
v.	In a DSSS modulation scheme with 14-stage linear feed-back shift register, the period of PN code sequence will be (a) 16384 (b) 8192 (c) 16383 (d) 1024	
vi.	The effect of ISI can be studied through (a) Eye diagram (b) Equalizer (c) Lissajous Pattern (d) none of the above	
vii.	The bit rate of digital communication system is R kbit/s. The modulation used is 32-QAM. The minimum bandwidth required for ISI free transmission is (a) R/10 Hz (b) R/10 KHz (c) R/5 Hz (d) R/5 KHz	
viii.	A bandlimited signal is sampled at the Nyquist rate. The signal can be recovered by passing the samples through (a) an RC filter (b) an envelope detector (c) a PLL (d) an ideal low-pass filter with the appropriate bandwidth	
ix.	In a digital communication environment, a signal bit with energy 5 pico joules is to be transmitted at a data rate of 1Mbps. Then the required transmission power will be; (a) 5 μ watts (b) 2.5 pico- watts (c) 2.5 μ watts (d) 5 pico-watts	

x.	In orthogonal FSK, the distance between any two signal points is always; (a) $\sqrt{2E}$ (b) $\sqrt{E}$ (c) $2\sqrt{E}$ (d) $\sqrt{3E}$	
Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	What is constellation diagram? What are the different types of information a communication engineer will derive just by looking at this diagram.	
ii.	Briefly state the different types of sampling techniques adopted. Which one is the best one and why?	
iii.	State the advantages of spread spectrum modulation techniques.	
iv.	What is ISI? How it can be removed?	
Q.3A	Explain briefly the principle of PCM system through a suitable diagram.	05
Q.3B	Explain the principle of delta modulation (DM). Draw the typical block diagram of DM modulator.	05
Q.4A	State the utility of eye diagram. Draw a typical eye diagram and label it properly.	05
Q.4B	State and prove the Nyquist criterion on zero ISI.	05
Q.5A	State the principle of a typical baseband communication system through a simple block diagram. Derive the expression of a received signal in presence of Inter-symbol Interference (ISI). For simplicity ignore the other disturbances.	05
Q.5B	Draw the block diagram of a typical coherent BPSK receiver. Explain its operation briefly.	05
Q.6A	Explain through a suitable block a 3 stage PN sequence generator. Assuming initial values of 110 generate the PN sequence. Specify the various properties of a typical pseudo noise.	05
Q.6B	Define the parameters Processing Gain & Jamming Margin. Establish the relation between the two. In a typical CDMA- DSSS system of 9.6 kbps data rate and 1.2288 MHz spread bandwidth, determine the Processing Gain(PG) and Jamming Margin (JM) for target $(E_b/N_0)_{\min}$ of 6dB .	05
	OR	
Q.6B	State the basic requirements of a spread spectrum system. Through a block diagram explain the basic function of a DSSS transmitter.	05
Q.7A	State the advantages of digital Communication over analog communication. Draw the block diagram of a typical ASK transmitter. Draw the modulated output waveforms also.	05
Q.7B	What is FHSS? State the difference between slow and fast hopped spread spectrum system. State the advantages of FHSS over DSSS.	05
	OR	
Q.7B	A 3-stage shift register with a linear feedback generates the sequence 01011100101110 then (a) determine period of the given infinite sequence (b) verify all the properties of the PN sequence for the given sequence	05
Q.8A	For the signals $s_1(t)$, $s_2(t)$, & $s_3(t)$ as given below, find the Orthonormal basis using Gram-Schmidt Orthogonalization (GSO) procedure. Draw the	10

constellation diagram and show the locations of all signal points. Obtain the minimum distance between any two points.

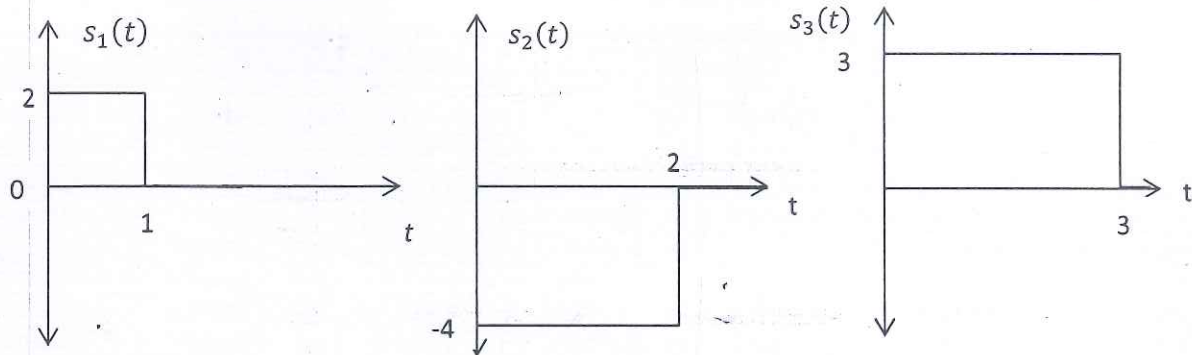


Figure for Q. No. 8

Q.9A	State the advantages of DPSK modulation. Draw a simple block diagram to explain the process of DPSK signal generation. For a data sequence of "10110110" with NRZ-Unipolar encoding, draw various waveforms including that to be applied to the balanced modulator.	10
Q.9B	Binary data are transmitted at a rate of 2 Mbps over a microwave link. Assuming channel noise as AWGN with zero mean and power spectral density at the receiver input, is 10^{-10} Watts/Hz, find the average carrier power required to maintain an average probability of error $P_e \leq 10^{-5}$ for coherent binary FSK. Determine also the required the minimum channel bandwidth.	10
OR		
Q.9B	A binary data is transmitted using ASK over an AWGN channel at a rate of 2.5 Mbps. The carrier amplitude at the receiver is 1mV. Noise power spectral density is 10^{-15} Watts/Hz. Find the average Probability of error if the detection is non-coherent.	10

Complementary Error Function Table													
x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)	x	erfc(x)
0	1.000000	0.5	0.479500	1	0.157299	1.5	0.033895	2	0.004678	2.5	0.000407	3	0.00002209
0.01	0.988717	0.51	0.470756	1.01	0.153190	1.51	0.032723	2.01	0.004475	2.51	0.000386	3.01	0.00002074
0.02	0.977435	0.52	0.462101	1.02	0.149162	1.52	0.031587	2.02	0.004281	2.52	0.000365	3.02	0.00001947
0.03	0.966159	0.53	0.453536	1.03	0.145216	1.53	0.030484	2.03	0.004094	2.53	0.000346	3.03	0.00001827
0.04	0.954889	0.54	0.445061	1.04	0.141350	1.54	0.029414	2.04	0.003914	2.54	0.000328	3.04	0.00001714
0.05	0.943628	0.55	0.436677	1.05	0.137564	1.55	0.028377	2.05	0.003742	2.55	0.000311	3.05	0.00001608
0.06	0.932378	0.56	0.428384	1.06	0.133856	1.56	0.027372	2.06	0.003577	2.56	0.000294	3.06	0.00001508
0.07	0.921142	0.57	0.420184	1.07	0.130227	1.57	0.026397	2.07	0.003418	2.57	0.000278	3.07	0.00001414
0.08	0.909922	0.58	0.412077	1.08	0.126674	1.58	0.025453	2.08	0.003266	2.58	0.000264	3.08	0.00001326
0.09	0.898719	0.59	0.404064	1.09	0.123197	1.59	0.024538	2.09	0.003120	2.59	0.000249	3.09	0.00001243
0.1	0.887537	0.6	0.396144	1.1	0.119795	1.6	0.023652	2.1	0.002979	2.6	0.000236	3.1	0.00001165
0.11	0.876377	0.61	0.388319	1.11	0.116467	1.61	0.022793	2.11	0.002845	2.61	0.000223	3.11	0.00001092
0.12	0.865242	0.62	0.380589	1.12	0.113212	1.62	0.021962	2.12	0.002716	2.62	0.000211	3.12	0.00001023
0.13	0.854133	0.63	0.372954	1.13	0.110029	1.63	0.021157	2.13	0.002593	2.63	0.000200	3.13	0.00000958
0.14	0.843053	0.64	0.365414	1.14	0.106918	1.64	0.020378	2.14	0.002475	2.64	0.000189	3.14	0.00000897
0.15	0.832004	0.65	0.357971	1.15	0.103876	1.65	0.019624	2.15	0.002361	2.65	0.000178	3.15	0.00000840
0.16	0.820988	0.66	0.350623	1.16	0.100904	1.66	0.018895	2.16	0.002253	2.66	0.000169	3.16	0.00000786
0.17	0.810008	0.67	0.343372	1.17	0.098000	1.67	0.018190	2.17	0.002149	2.67	0.000159	3.17	0.00000736
0.18	0.799064	0.68	0.336218	1.18	0.095163	1.68	0.017507	2.18	0.002049	2.68	0.000151	3.18	0.00000689
0.19	0.788160	0.69	0.329160	1.19	0.092392	1.69	0.016847	2.19	0.001954	2.69	0.000142	3.19	0.00000644
0.2	0.777297	0.7	0.322199	1.2	0.089686	1.7	0.016210	2.2	0.001863	2.7	0.000134	3.2	0.00000603
0.21	0.766478	0.71	0.315335	1.21	0.087045	1.71	0.015593	2.21	0.001776	2.71	0.000127	3.21	0.00000564
0.22	0.755704	0.72	0.308567	1.22	0.084466	1.72	0.014997	2.22	0.001692	2.72	0.000120	3.22	0.00000527
0.23	0.744977	0.73	0.301896	1.23	0.081950	1.73	0.014422	2.23	0.001612	2.73	0.000113	3.23	0.00000493
0.24	0.734300	0.74	0.295322	1.24	0.079495	1.74	0.013865	2.24	0.001536	2.74	0.000107	3.24	0.00000460
0.25	0.723674	0.75	0.288845	1.25	0.077100	1.75	0.013328	2.25	0.001463	2.75	0.000101	3.25	0.00000430
0.26	0.713100	0.76	0.282463	1.26	0.074764	1.76	0.012810	2.26	0.001393	2.76	0.000095	3.26	0.00000402
0.27	0.702582	0.77	0.276179	1.27	0.072486	1.77	0.012309	2.27	0.001326	2.77	0.000090	3.27	0.00000376
0.28	0.692120	0.78	0.269990	1.28	0.070266	1.78	0.011826	2.28	0.001262	2.78	0.000084	3.28	0.00000351
0.29	0.681717	0.79	0.263897	1.29	0.068101	1.79	0.011359	2.29	0.001201	2.79	0.000080	3.29	0.00000328
0.3	0.671373	0.8	0.257899	1.3	0.065992	1.8	0.010909	2.3	0.001143	2.8	0.000075	3.3	0.00000306
0.31	0.661092	0.81	0.251997	1.31	0.063937	1.81	0.010475	2.31	0.001088	2.81	0.000071	3.31	0.00000285
0.32	0.650874	0.82	0.246189	1.32	0.061935	1.82	0.010057	2.32	0.001034	2.82	0.000067	3.32	0.00000266
0.33	0.640721	0.83	0.240476	1.33	0.059985	1.83	0.009653	2.33	0.000984	2.83	0.000063	3.33	0.00000249
0.34	0.630635	0.84	0.234857	1.34	0.058086	1.84	0.009264	2.34	0.000935	2.84	0.000059	3.34	0.00000232
0.35	0.620618	0.85	0.229332	1.35	0.056238	1.85	0.008889	2.35	0.000889	2.85	0.000056	3.35	0.00000216
0.36	0.610670	0.86	0.223900	1.36	0.054439	1.86	0.008528	2.36	0.000845	2.86	0.000052	3.36	0.00000202
0.37	0.600794	0.87	0.218560	1.37	0.052688	1.87	0.008179	2.37	0.000803	2.87	0.000049	3.37	0.00000188
0.38	0.590991	0.88	0.213313	1.38	0.050984	1.88	0.007844	2.38	0.000763	2.88	0.000046	3.38	0.00000175
0.39	0.581261	0.89	0.208157	1.39	0.049327	1.89	0.007521	2.39	0.000725	2.89	0.000044	3.39	0.00000163
0.4	0.571608	0.9	0.203092	1.4	0.047715	1.9	0.007210	2.4	0.000689	2.9	0.000041	3.4	0.00000152
0.41	0.562031	0.91	0.198117	1.41	0.046148	1.91	0.006910	2.41	0.000654	2.91	0.000039	3.41	0.00000142
0.42	0.552532	0.92	0.193232	1.42	0.044624	1.92	0.006622	2.42	0.000621	2.92	0.000036	3.42	0.00000132
0.43	0.543113	0.93	0.188437	1.43	0.043143	1.93	0.006344	2.43	0.000589	2.93	0.000034	3.43	0.00000123
0.44	0.533775	0.94	0.183729	1.44	0.041703	1.94	0.006077	2.44	0.000559	2.94	0.000032	3.44	0.00000115
0.45	0.524518	0.95	0.179109	1.45	0.040305	1.95	0.005821	2.45	0.000531	2.95	0.000030	3.45	0.00000107
0.46	0.515345	0.96	0.174576	1.46	0.038946	1.96	0.005574	2.46	0.000503	2.96	0.000028	3.46	0.00000099
0.47	0.506255	0.97	0.170130	1.47	0.037627	1.97	0.005336	2.47	0.000477	2.97	0.000027	3.47	0.00000092
0.48	0.497250	0.98	0.165769	1.48	0.036346	1.98	0.005108	2.48	0.000453	2.98	0.000025	3.48	0.00000086
0.49	0.488332	0.99	0.161492	1.49	0.035102	1.99	0.004889	2.49	0.000429	2.99	0.000024	3.49	0.00000080