COLLEGE OF ENGINEERING, PUNE
DEPRTMENT OF MATHEMATICS

Class: S.Y.B.Tech(Instrumentation) **MA224** **MAX. MARKS:50**

END SEMESTER EXAMINATION **Time: 3Hrs**

Instructions to candidates

1. Answer Each Section **SEPERATELY.**
2. Solve any Four questions from section II
3. Read the instructions carefully.
4. Use of non-programmable calculators are allowed.

SECTION I

Q. 1 A Define unbiased estimator and show that S^2 is an unbiased estimator of the parameter σ^2 **03**

B Many cardiac patients were implemented pacemakers to control their heartbeat. A plastic connector module mounts on the top of the pacemaker. Assuming a std. dev. Of 0.0015 and an approximate normal distribution; (1) Find a 95% confidence interval for the mean of all connector modules made by a certain manufacturing company. A random sample of 75 modules has an avg. of 0.310 inch. (2) How large a sample is needed in above example if we wish to be 95% confidence that our sample mean will be within 0.0005 inch of the true mean. **04**

OR

B A machine is producing metal piece that are cylindrical in shape. A sample of piece is taken and the diameters are 1.01,0.97,1.03,1.04,0.89,0.98,0.99,1.01 and 1.03 cm. Find a 99% confidence interval for the mean diameter of piece from this machine, assuming an approximate normal distribution. **04**

C A manufacturer of car batteries claims that his batteries will last on average 3 years with a variance of 1 year. If 5 of these batteries have lifetimes of 1.9, 2.4, 3.0, 3.5 & 4.2 years, construct a 90% confidence interval for σ^2 and decide if the manufacturer's claim that $\sigma^2 = 1$ is valid. Assume the population of battery lives to be approximately normally distributed. **03**

SECTION II

Q.1 A Define signal. How are the signals classified? **04**

B Define system. Classify the systems on the basis of their properties with suitable examples. **06**

Q. 2 A Find the convolution of the following sequences using graphical method. **05**

$$x(n) = \{1,2,2,1\}$$
$$h(n) = \{2,1,2\}$$

B A system is described by the difference equation, **05**

$$y(n) + 0.1y(n-1) - 0.2y(n-2) = x(n) + x(n-1)$$

Determine the system transfer function H(z)

Q.3 A Find DTFT of $x(n) = a^n u(n) + a^{-n}u(-n-1)$ **06**

B Prove the Convolution property of z transform **04**

Q.4 A Find the circular convolution of $x(n) = \{1,1,1,1\} and\ h(n) = \{2,1,2,1\}$ using the circular convolution property of the DFT. **04**

B Explain the aliasing problem in sampling scheme 02

C The following signals are sampled with sampling frequency 40 Hz. Find out the resulting discrete signals and comment on it. 04

$x_1(t) = \cos 20\pi t;\ x_2(t) = \cos 100\pi t;$

Q.5 A Obtain the Fourier transform of the following 04

i. $x(t) = e^{-at}u(t)$

ii. $x(t) = e^{-at}u(-t)$

B Solve the difference equation (assuming all initial conditions are zero) 03

$y(n+2) - y(n+1) + 0.25\, y(n) = u(n+2)$

Where $u(n) = 1\ for\ n \geq 0\ and\ u(n) = 0\ for\ n < 0$

C State the properties of region of convergence of z transform 03

Table A.3 (continued) Areas under the Normal Curve

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767

Table A.5 Critical Values of the Chi-Squared Distribution

	α									
v	0.995	0.99	0.98	0.975	0.95	0.90	0.80	0.75	0.70	0.50
1	0.0^4393	0.0^3157	0.0^3628	0.0^3982	0.00393	0.0158	0.0642	0.102	0.148	0.455
2	0.0100	0.0201	0.0404	0.0506	0.103	0.211	0.446	0.575	0.713	1.386
3	0.0717	0.115	0.185	0.216	0.352	0.584	1.005	1.213	1.424	2.366
4	0.207	0.297	0.429	0.484	0.711	1.064	1.649	1.923	2.195	3.357
5	0.412	0.554	0.752	0.831	1.145	1.610	2.343	2.675	3.000	4.351
6	0.676	0.872	1.134	1.237	1.635	2.204	3.070	3.455	3.828	5.348
7	0.989	1.239	1.564	1.690	2.167	2.833	3.822	4.255	4.671	6.346
8	1.344	1.647	2.032	2.180	2.733	3.490	4.594	5.071	5.527	7.344
9	1.735	2.088	2.532	2.700	3.325	4.168	5.380	5.899	6.393	8.343
10	2.156	2.558	3.059	3.247	3.940	4.865	6.179	6.737	7.267	9.342

Table A.5 (continued) Critical Values of the Chi-Squared Distribution

	α									
v	0.30	0.25	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001
1	1.074	1.323	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827
2	2.408	2.773	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815
3	3.665	4.108	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.266
4	4.878	5.385	5.989	7.779	9.488	11.143	11.668	13.277	14.860	18.466
5	6.064	6.626	7.289	9.236	11.070	12.832	13.388	15.086	16.750	20.515
6	7.231	7.841	8.558	10.645	12.592	14.449	15.033	16.812	18.548	22.457
7	8.383	9.037	9.803	12.017	14.067	16.013	16.622	18.475	20.278	24.321
8	9.524	10.219	11.030	13.362	15.507	17.535	18.168	20.090	21.955	26.124
9	10.656	11.389	12.242	14.684	16.919	19.023	19.679	21.666	23.589	27.877
10	11.781	12.549	13.442	15.987	18.307	20.483	21.161	23.209	25.188	29.588

Table A.4 (continued) Critical Values of the t-Distribution

	α					
v	0.02	0.015	0.01	0.0075	0.005	0.0025
1	15.894	21.205	31.821	42.433	63.656	127.321
2	4.849	5.643	6.965	8.073	9.925	14.089
3	3.482	3.896	4.541	5.047	5.841	7.453
4	2.999	3.298	3.747	4.088	4.604	5.598
5	2.757	3.003	3.365	3.634	4.032	4.773
6	2.612	2.829	3.143	3.372	3.707	4.317
7	2.517	2.715	2.998	3.203	3.499	4.029
8	2.449	2.634	2.896	3.085	3.355	3.833