

## Jaypee University of Information Technology, Waknaghat

Test-2 Examination, April 2018

B.Tech (ECE/CSE/IT) - Semester IV

Course Title: Probability Theory and Random Processes  
 Course Code: 10B11MA411  
 Course Credits: 4

Max. Marks: 25 marks

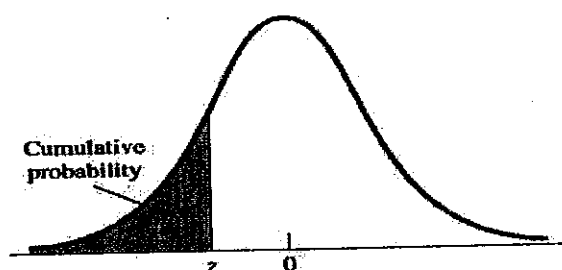
Max. Time: 90 minutes

**Note:** Answer all the questions. Define **random variables** along with range where applicable.  
 Scientific calculators are allowed. Necessary statistical tables are supplied.

1. Suppose that the random variable  $\mathbf{X}$  has the following *cumulative distribution function*:

$$F_{\mathbf{X}}(x) = \begin{cases} 0 & , \quad x \leq 0 \\ x^3 & , \quad 0 \leq x \leq 1 \\ 1 & , \quad x \geq 1 \end{cases}$$

- (a) Compute  $\mathbb{P}(\mathbf{X} > 0.5)$  and  $\mathbb{P}(0.2 < \mathbf{X} \leq 0.8)$  by only using  $F(x)$ .  
 (b) Find the *probability density function* of  $\mathbf{X}$ . (4 Marks)
2. Let  $\mathbf{X} \sim \text{Uniform}(0, 1)$ . Determine the *probability density function* of  $\mathbf{X}^2$ . (4 Marks)
3. A medical researcher estimates that 0.00004 of the population has a rare blood disorder. If the researcher randomly selects 100,000 people from the population, what is the *approximate* probability that more than 3 people will have this disorder? (4 Marks)
4. Suppose the waiting time for service at the post office has an exponential distribution with mean 3 minutes. If you enter the post office immediately behind another customer, what is the probability you wait over 5 minutes? (4 Marks)
5. The employees of a firm that manufactures insulation are being tested for indications of asbestos in their lungs. The firm is requested to send three employees who have positive indications of asbestos on to a medical center for further testing. Suppose that 40% of the employees have positive indications of asbestos in their lungs. (4 Marks)
- (a) Find the probability that ten employees must be tested in order to find three positives.  
 (b) Define the random variable of interest along with its *probability mass function*.
6. *TraWell.in* is an internet-based travel agency wherein the customers can buy packages for places they plan to visit. The number of daily hits at its website is Normally distributed with  $\mu = 1000$  and  $\sigma = 240$ . (5 Marks)
- (a) What is the probability of getting fewer than 900 hits?  
 (b) The website of this company has a limited bandwidth, which is measured in terms of the number of hits the site can handle. How large a bandwidth should *TraWell.in* have in order to handle 99% of the daily traffic?



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-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641