



QUESTION BANK

Year / Semester: **II B.Tech IV Semester**

Regulation: **R23**

Subject and Code: **COMPLEX VARIABLES, PROBABILITY AND STATISTICS-23BSC241**

SYLLABUS

UNIT I: Complex Variable – Differentiation (09)

Introduction to functions of complex variable-concept of Limit & continuity- Differentiation, Cauchy-Riemann equations, analytic functions harmonic functions, finding harmonic conjugate-construction of analytic function by MilneThomson method.

UNIT II: Complex Variable – Integration (09)

Line integral - Cauchy's integral theorem(Simple Case), Cauchy Integral formula, Power series expansions: Taylor's series, Laurent's series, zeros of analytic functions, singularities. Residues, Cauchy Residue theorem (without proof).

UNIT III: Probability theory (09)

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem

UNIT IV: Random variables & Distributions (09)

Random variables (discrete and continuous), probability density functions, properties, mathematical expectation Probability distribution - Binomial, Poisson approximation to the binomial distribution, Normal distribution and their properties

UNIT V: Estimation and Testing of hypothesis, large sample tests (09)

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems



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Max Marks: 10

S.No.	CO	Questions	BT
UNIT I: COMPLEX VARIABLE – DIFFERENTIATION			
1	1	A.Show that $\sin z = \sin x \cosh y + i \cos x \sinh y$ B. Show that $\cos z = \cos x \cosh y - i \sin x \sinh y$	L2
2	1	If $\sin (A + iB) = x + iy$ then a) $\frac{x^2}{\cosh^2 B} + \frac{y^2}{\sinh^2 B} = 1$ b) $\frac{x^2}{\sin^2 A} - \frac{y^2}{\cos^2 A} = 1$	L2
3	1	If $\cos (A + iB) = x + iy$ then a) $\frac{x^2}{\cos^2 A} - \frac{y^2}{\sin^2 A} = 1$ b) $\frac{x^2}{\cosh^2 B} + \frac{y^2}{\sinh^2 B} = 1$	L2
4	1	Prove that $f(z) = z^2$ is analytic everywhere and hence find its derivative.	L2
5	1	Prove that $f(z) = z^3$ is analytic everywhere and hence find its derivative.	L2
6	1	Show that $f(z) = e^z$ is analytic everywhere and hence find its derivative	L2
7	1	Show that $f(z) = \sin z$ is analytic everywhere and hence find its derivative	L2
8	1	Find the Analytic function whose real part is $x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$	L2
9	1	Find the analytic function whose imaginary part is $3x^2y - y^3$	L2
10	1	Find $f(z)$ where $V = x^2 - y^2 + \frac{x}{x^2+y^2}$	L2



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UNIT II: COMPLEX VARIABLE-INTEGRATION			
1	2	Evaluate $\int_C f(z)dz$ where $f(z) = y - x - 3x^2$ and C is a straight line $y = x$ from $z=0$ to $z=1+i$	L2
2	2	Evaluate $\int_C \frac{e^z}{(z-1)^2} dz$ where C is the circle $ z = 2$	L2
3	2	Evaluate $\int_C \frac{\sin(z)}{\left(z - \frac{\pi}{6}\right)^2} dz$ where C is the circle $ z = 1$	L2
4	2	Evaluate $\oint_C \frac{e^z}{(z-1)(z-2)} dz$; where C is the circle $ z = 3$	L2
5	2	Expand $f(z) = \sin z$ in Taylor's series about $z = \frac{\pi}{4}$	L2
6	2	Expand $f(z) = \cos z$ in Taylor's series about $z = \frac{\pi}{2}$	L2
7	2	Determine the poles and residues at each pole of $f(z) = \frac{z+2}{(z-2)(z+1)^2}$	L2
8	2	Find the poles and residues at each pole of $f(z) = \frac{z}{(z-1)(z-2)}$	L2
9	2	Evaluate $\int_C \frac{1-2z}{z(z+1)(z-3)} dz$ where C is $ z = 2$ by residue Theorem	L3
10	2	Evaluate $\int_C \frac{z^3}{(z-1)^2(z-3)} dz$ $C : z = 2$ using residue theorem	L3



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S.No.	CO	Questions	BT
UNIT III: PROBABILITY THEORY			
1	3	Prove that $P(A \cup B) = P(A) + P(B) - P(A \cap B)$	L2
2	3	Prove that $P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C) - P(A \cap C) + P(A \cap B \cap C)$	L2
3	3	A Probability of horse A winning a race is $\frac{1}{5}$ and probability of horse B winning a race is $\frac{1}{4}$. What is the probability that (1) Either of them will win (2) None of them will win	L2
4	3	60 Boys and 20 girls are in a class. Half of the boys and half of the girls of the class play cricket. Find the probability of the selected person is boy or girl playing cricket.	L2
5	3	A class has 10 boys and 5 girls. Three students are selected at random one after the other. Find the probability that (i) First two are boys and third is girls (ii) First and third of same sex and second is of opposite sex	L2
6	3	Among 150 students 80 students studying maths, 40 students studying physics, 30 students studying maths and physics. If a student is chosen at random, find the probability that the student (i) Studying maths or physics (ii) studying neither maths nor physics	L2
7	3	State and prove Baye's theorem.	L2
8	3	Box 1 containing 1 white 999 red balls, Box 2 containing 1 red 999 white balls. A ball is picked from a randomly selected box. If the ball is red, what is the probability that it comes from Box 1.	L2
9	3	Box 1 containing 1 white 2 red 3 green balls, Box 2 containing 2 white 3 red 1 green ball and Box 3 containing 3 white 1 red 2 green balls. 2 balls are dram at random from a box, these are found to be 1 white and 1 red. Determine the probability that the balls are drawn from box 2.	L3
10	3	A businessman goes to hotels X, Y, Z. 20%, 50%, 30% of the time respectively. It is known that 5%, 4%, 8% of the rooms in X, Y, Z hotels have faulty plumbing's. What is the probability that business man's room having faulty plumbing is assigned to hotel Z?	L3



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UNIT IV: RANDOM VARIABLES & DISTRIBUTIONS																					
1	4	A random variable X has the following distribution <table border="1" style="margin-left: auto; margin-right: auto;"><tr><td>X</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>P(X)</td><td>k</td><td>2k</td><td>3k</td><td>4k</td><td>5k</td><td>6k</td><td>7k</td><td>8k</td></tr></table> Determine (i) k (ii) Mean (iii) Variance (iv) Standard deviation	X	1	2	3	4	5	6	7	8	P(X)	k	2k	3k	4k	5k	6k	7k	8k	L2
X	1	2	3	4	5	6	7	8													
P(X)	k	2k	3k	4k	5k	6k	7k	8k													
2	4	A random variable X has the following probability function <table border="1" style="margin-left: auto; margin-right: auto;"><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>P(x)</td><td>0</td><td>k</td><td>2k</td><td>2k</td><td>3k</td><td>k²</td><td>2k²</td><td>7k² + k</td></tr></table> Determine (i) k (ii) Mean (iii) Variance (iv) Standard deviation	x	0	1	2	3	4	5	6	7	P(x)	0	k	2k	2k	3k	k ²	2k ²	7k ² + k	L2
x	0	1	2	3	4	5	6	7													
P(x)	0	k	2k	2k	3k	k ²	2k ²	7k ² + k													
3	4	If the random variable has probability density function i.e., $f(x) = \begin{cases} k(x^2 - 1), & -1 < x < 3 \\ 0, & \text{otherwise} \end{cases}$ then find (i)k (ii) $P(\frac{1}{2} \leq x \leq \frac{5}{2})$	L2																		
4	4	Show that mean = np and variance = npq of Binomial distribution.	L2																		
5	4	The mean and variance of a Binomial variable 'x' with parameter 'n' and 'p' are 16 and 8 respectively. Find $P(x \geq 1)$ and $P(x > 2)$	L3																		
6	4	A dice is thrown 8 times and it is required to find probability of getting 3 (i) Exactly 2 times (ii) Atmost 1 time (iii) Atleast 2 times	L3																		
7	4	Show that mean and variance of the Poisson distribution is same	L3																		
8	4	If the Poission distribution is such that $\frac{3}{2}P(X = 1) = P(X = 3)$. Find (i) $P(X \geq 1)$ (ii) $P(2 \leq X \leq 5)$	L3																		
9	4	Average number of accidents on any day on a national highway is 1.8. Determine the probability that the number of accidents are (1) at least 1 (2) At most 1	L3																		
10	4	State Characteristics of Normal Probability distribution	L3																		



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UNIT V: ESTIMATION AND TESTING OF HYPOTHESIS, LARGE SAMPLE TESTS			
1	5	A population consists of 5 numbers 2, 3, 6, 8 and 11 consider all possible samples of size 2 which can be drawn (i) with replacement from this population, Find (a) The Mean of the population (b) The Standard Deviation of the Population (c) Mean of the sampling distribution of Means (d) The Standard Deviation of the Sampling Distribution of means	L2
2	5	A population consists of five numbers 4, 8, 12, 16, 20. Consider all samples of size 2 which can be drawn without replacement from this population. Find (a) The population mean (b) The population standard deviation (c) The mean of sampling distribution of means (d) The standard deviation of sampling distribution of means	L2
3	5	A sample of 400 items is taken from a population whose standard deviation is 10. The mean of the sample is 40. Test whether the sample has come from a population with mean 38. Also calculate 95% confidence interval for the population.	L2
4	5	The Means of two large samples of sizes 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of S.D. 2.5 inches.	L2
5	5	In a big city 250 men out of 750 men were found to be smokers. Does the information support the conclusion that the majority of men this city are smokers?	L2
6	5	The height of 10 males of a given location is found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches reasonable to believe that the average height is greater than 64 inches? Test at 5% LOS.	L2
7	5	In a random sample of 60 workers, the average time taken by them to get to work is 33.8 minutes with a standard deviation of 6.1 minutes. Can we reject the null hypothesis $\mu=32.6$ minutes in favour of alternative null hypothesis $\mu > 32.6$ at $\alpha = 0.025$ level of significance.	L2
8	5	In a big city 250 men out of 750 men were found to be smokers. Does the information support the conclusion that the majority of men this city are smokers	L2



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9	5	a) To examine the hypothesis that the Husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administered them a test which measures the I.Q. the results are as follows: Test the hypothesis with reasonable test at 0.05 L.O.S	L2																						
		<table border="1"><tr><td>Husbands</td><td>117</td><td>105</td><td>97</td><td>105</td><td>123</td><td>109</td><td>86</td><td>78</td><td>103</td><td>107</td></tr><tr><td>Wives</td><td>106</td><td>98</td><td>87</td><td>104</td><td>116</td><td>95</td><td>90</td><td>69</td><td>108</td><td>85</td></tr></table>	Husbands	117	105	97	105	123	109	86	78	103	107	Wives	106	98	87	104	116	95	90	69	108	85	
Husbands	117	105	97	105	123	109	86	78	103	107															
Wives	106	98	87	104	116	95	90	69	108	85															
10	5	Two Horses A and B were tested according to the time (in seconds) to run a particular track with the following results. Test whether two horses have same running capacity (Difference of Two Means)	L2																						
		<table border="1"><tr><td>Horse A</td><td>28</td><td>30</td><td>32</td><td>33</td><td>33</td><td>29</td><td>34</td></tr><tr><td>Horse B</td><td>29</td><td>30</td><td>30</td><td>24</td><td>27</td><td>29</td><td>-</td></tr></table>	Horse A	28	30	32	33	33	29	34	Horse B	29	30	30	24	27	29	-							
Horse A	28	30	32	33	33	29	34																		
Horse B	29	30	30	24	27	29	-																		

Note: L1-Remembering, L2-Understanding, L3-Appling, L4-Analyzing, L5-Evaluating, and L6-Creating

Instruction to Faculty Members:

The Six Levels of Bloom's Taxonomy:

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory (e.g., list, define, name, locate).
2. **Understanding:** Constructing meaning, explaining ideas, or concepts (e.g., summarize, interpret, classify, compare).
3. **Applying:** Using information in new situations or implementing procedures to solve problems (e.g., solve, use, demonstrate, implement).
4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure (e.g., contrast, categorize, distinguish, diagram).
5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing (e.g., judge, critique, justify, defend, argue).
6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure (e.g., design, construct, develop, formulate).