Techno India NJR Institute of Technology

Course File

Advanced Engineering Mathematics

(3CS201)

Dr. Kalpana Fatawat
(Associate Professor)
Department of Computer Science

For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

II Year-III Semester: B.Tech. Computer Science and Engineering

3CS2-01: Advanced Engineering Mathematics

Credit-3
3L+0T+0P

Max. Marks : 150 (IA:30,ETE:120)
End Term Exam: 3 Hours

SN	CONTENTS	Hours
1	**Random Variables:** Discrete and Continuous random variables, Joint distribution, Probability distribution function, conditional distribution.Mathematical Expectations: Moments, Moment Generating Functions, variance and correlation coefficients, Chebyshev's Inequality, Skewness and Kurtosis.	7
2	**Binomial distribution**, Normal Distribution, Poisson Distribution and their relations, Uniform Distribution, Exponential Distribution. Correlation: Karl Pearson's coefficient, Rank correlation. Curve fitting. Line of Regression.	5
3	**Historical development**, Engineering Applications of Optimization, Formulation of Design Problems as a Mathematical Programming Problems, Classification of Optimization Problems	8
4	**Classical Optimization using Differential Calculus:** Single Variable and Multivariable Optimization with & without Constraints, Langrangian theory, Kuhn Tucker conditions	6
5	**Linear Programming:** Simplex method, Two Phase Method and Duality in Linear Programming. Application of Linear Programming: Transportation and Assignment Problems.	14
	TOTAL	**40**

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Course Overview:

In this 47-hour course, students will learn the concepts of Advance Mathematics and its applications in different branches of Computer Science. How it is fruitful in classifying and analyzing the data will also be emphasized.

Course Outcomes:

CO. NO.	Cognitive Level	Course Outcome
1	Knowledge	To learn the concepts and principles of Random variable and Probability distribution
2	Application	Students are able to apply different prob. Dist. To identify and solve real life problem.
3	Analysis	To learn the formulation of different mathematical problems into optimization problems and application in Engineering field.
4	Application	Apply the principles of optimization using differential calculus
5	Synthesis	Student able to formulate real life problem into LPP, transformation and assignment problem.

Prerequisites:

- Understanding of basic Statistics
- Understanding of basic high-school mathematics.
- Aware of basic matrices operations.

Advanced Engineering Mathematics Year of Study: 2017-18												
Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO
CO236.1	3	1	0	2	2	0	0	0	0	0	1	2
CO236.2	2	2	2	2	0	0	0	0	0	0	1	2
CO236.3	3	2	1	0	0	0	0	0	0	2	1	2
CO236.4	2	1	2	2	2	2	0	0	2	0	1	0

Course Coverage Module Wise:

Lecture plan based on Unit 1

Lecture Sl. No.	Topic
1	Student is able to grasp type of variables.
2	Student becomes familiar different types of probability distribution.
3	Student is able to grasp the concept of moments.
4	Student should be able to identify the generating functions.
5	Student becomes familiar with Kurtosis and Skewness.

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Lecture plan based on Unit 2

Lecture Sl. No.	Topic
6	Introduction to various distributions.
7	Student is able to grasp concept of Normal Distribution and its applications.
8	Student becomes familiar with the concepts Poisson distribution and its applications.
9	Student is able to compare the normal and Poisson distribution.
10	Student becomes familiar with uniform and exponential distributions.
11	Student is able to grasp concept of correlation coefficient.

Lecture plan based on Unit 3

Lecture Sl. No.	Topic
12	Student is able to grasp the concept of optimization.
13	Student becomes familiar with its applications.
14	Student is able to design the mathematical programming.
15	Student is able to carry out the comparative study.

Lecture plan based on Unit 4

Lecture Sl. No.	Topic
16	Student becomes familiar with basic differential calculus.
17	Student is able to grasp the concept of single and multi-variable optimization.

Lecture plan based on Unit 5

Lecture Sl. No.	Topic
18	Student is able to understand Simplex method.
19	Student is able to grasp the concept of two phase method.
20	Student is able to grasp the concept of Duality.
21	Applications of LPP in Transportation problems.
22	Applications of LPP in Assignment problems.

TEXT/REFERENCE BOOKS

- Advanced Engineering Mathematics (RTU), Gokharoo & Saini, Navakar Publications.
- Fundamentals of Mathematical Statistics, S.C. Gupta & V.K. Kapoor, Sultan Chand & Sons.

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- Optimization Techniques (RTU), Gokharoo & Saini, Navkar Publications.

Teaching and Learning resources:

Unit 1

https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library/random-variables-discrete/v/random-variables

https://www.youtube.com/watch?v=5ghhMZjV65g

http://www.igntu.ac.in/eContent/IGNTU-eContent-467281593500-B.Com-4-Prof.ShailendraSinghBhadouriaDean&-BUSINESSSTATISTICS-All.pdf

Unit 2

https://www.youtube.com/watch?v=BWcQ-ZFf_TU

https://www.youtube.com/watch?v=8MpgZJHcB8w

https://www.youtube.com/watch?v=8MpgZJHcB8w

Unit 3

https://nptel.ac.in/courses/111/105/111105039/

Unit 4

https://www.youtube.com/watch?v=qzXPaWI-BzM

Unit 5

https://www.youtube.com/watch?v=a2QgdDk4Xjw

https://www.youtube.com/watch?v=5Xg-1KLnslk

https://www.youtube.com/watch?v=RcPhmPhjMbc

https://www.youtube.com/watch?v=qxls3cYg8to

Assessment Methodology:

1. Assignments one from each unit and oral questioning.
2. Midterm subjective paper. (Twice during the semester)
3. Final paper at the end of the semester subjective.

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ADVANCED ENGINEERING MATHEMATICS QUESTION BANK

Unit 1

Explain the concept of random variable with examples.

What is mathematical expectation ? Explain with examples.

State the theorems on expection.

Determine the mean and variance of the random variable X having the following pr

$X = x$	1	2	3	4	5	6	7	8	9	10
$P(x)$	0.15	0.10	0.10	0.01	0.08	0.01	0.05	0.02	0.28	0.20

http://www.[illegible].com

Calculate the coefficient of correlation from the followi

X	1	2	3	4	5	6	7	8
Y	9	8	10	12	11	13	14	16

Unit 2

Explain the normal distribution and its limitations.

What is spearman rank correlation? Find the rank correlation for the following data:

The scores for nine students in physics and math are as follows:

- Physics: 35, 23, 47, 17, 10, 43, 9, 6, 28
- Mathematics: 30, 33, 45, 23, 8, 49, 12, 4, 31

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Patients arrive at a hospital accident and emergency department at ran
6 per hour.

(a) Find the probability that, during any 90 minute period, the number of
at the hospital accident and emergency department is

(i) exactly 7

(ii) at least 10

Unit 3

What is optimization ?

What are the application of optimization in engineering field ?

Unit 4

Consider the following N.L.P.P:

Minimize $Z=2x_1^2-24x_1+2x_2^2-8x_2+2x_3^2-12x_3+200$

Show that the function is convex. Solve the problem by solving each one-variable function by calculus.

What is the Kunh Tuker conditions ?

Unit 5

What are the various methods to solve a LPP? What do you mean by unbounded solution?

What is Duality?

Solve the following LPP :

$$\text{Maximize } Z = 3x_1 + 5x_2 + 4x_3 + 0s_1 + 0s_2 + 0s_3$$

subject to the constraints

(i) $2x_1 + 3x_2 + s_1 = 8$, (ii) $2x_2 + 5x_3 + s_2 = 10$, (iii) $3x_1 + 2x$

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3E1136

Total No o

3E1136

B. Tech. III - Sem. (Main / Back) Exam., Dec. 2

BSC Computer Science & Engineering

3CS2-01 Advanced Engineering Mathemati

CS, IT

Time: 3 Hours **Maximum**

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven qu Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any d missing may suitably be assumed and stated clearly. Units used /calculated must be stated clearly.

Use of following supporting material is permitted during (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only)

All questions are compulsory

Q.1 What is the coefficient of skewness, if the man and mode of the distribu

Q.2 What is the variance of the Poisson distribution with mean value 5?

Q.3 Define the exponential distribution.

Q.4 What is optimization?

Q.5 Match the following type of problems with their descriptions –

(a) Geometric programming problem (i) Classical optimization

(b) Quadratic programming problem (ii) Objective and constr

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http://www.rtuonline.com

Q.6 Write four engingeering applications of optimization.

Q.7 Consider the following problem –

Minimize $z = f(X)$,

Subject to $g_j(X) \leq 0; j = 1, 2, 3, \ldots, m$.

Then write the suitable Kuhn – Tucker conditions.

Q.8 What is difference between a slack and surplus variable?

Q.9 What happens when $m = n$ in a Linear Programming Problem (LPP)? W denotes the numbers of equation and decision variables respectively.

Q.10 For non – degenerate feasible solution of $m \times n$ transportation problen independent individual positive assignments will be required?

PART – B

(Analytical/Problem solving questions)

Attempt any five questions

Q.1 A box contains 'a' white and 'b' black balls, 'c' balls are drawn. Find the e of the number of white balls drawn. http://www.rtuonline.com

Q.2 The joint probability density function of a two – dimensional random vari given by –

$$f(x, y) = \begin{cases} 2, & 0 < x < 1, 0 < y < x \\ 0, & \text{elsewhere} \end{cases}$$

Find the marginal density functions of X and Y. Also find the cond function of Y given X = x and conditional density function of X.

Q.3 Fit a straight line to the following data –

X	1	2	3	4	6	8
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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The time (in hours) taken to produce each unit of the products A, B machines is displayed in the table below –

Machine	Lathe	Shaping	Milling
Product A	5	2	4
Product B	2	2	Nil
Product C	3	Nil	3

The profit per unit of the products A, B and C are ₹ 20, ₹ 15 and ₹ 1
Formulate the mathematical model to maximize the profit.

Q.5 Find the maximum and minimum value of the function –

$$u = x^3 + y^3 - 3x - 12y + 50$$

Q.6 Find the optimum of the following constrained multivariable problem –

Minimize $Z = -x_1^2 + (x_2 + 1)^2 + (x_3 - 1)^2$

Subject to $x_1 + 5x_2 - 3x_3 = 6$

$x_1, x_2, x_3 \geq 0.$

Q.7 Using two phase simplex method, solve the following linear programmi

Max. $z = -x_1 - x_2$

Subject to $3x_1 + 2x_2 \geq 30$

$-2x_1 - 3x_2 \leq -30$

$x_1 + x_2 \leq 5$

and $x_1, x_2 \geq 0$

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions)

Attempt any four questions

Q.1 (a) Find mean and variance of Poison distribution.

(b) How optimization problem are classified based on the nature of e

Q.2 (a) Using Simplex method, show that the following linear programm

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(b) Calculate the coefficient of correlation from the following data –

X	1	2	3	4	5	6	7	8	9
Y	9	8	10	12	11	13	14	16	15

Q.3 If the skulls are classified as A, B and C according as the length – breadt 75, between 75 and 80, or over 80. Using normal distribution find app mean and standard deviation of a series in which A are 58%, B are 38% being given that –

$$f(t) = \frac{1}{\sqrt{2\pi}} \int_0^t \exp(-x^2/2)dx,$$

then $f(0.20) = 0.08$ and $f(1.75) = 0.46$.

Q.4 Solve the following problem using Kuhn – Tucker conditions –

Minimize $f(x_1, x_2, x_3) = x_1^2 + x_2^2 + x_3^2$

$g_1 = 2x_1 + x_2 - 5 \le 0$

$g_2 = x_1 + x_3 - 2 \le 0$

$g_3 = 1 - x_1 \le 0$

$g_4 = 2 - x_2 \le 0$

$g_5 = -x_3 \le 0.$

Q.5 (a) Write the dual of the following problem –

Minimize $z = 2x_1 + x_2$

Subject to $3x_1 + x_2 \ge 3,\ 4x_1 + 3x_2 \ge 6,\ x_1 + 2x_2 \ge 2$

and $x_1, x_2, x_3 \ge 0$

(b) Using Vogel's Approximation method, find basic feasible sol following unbalanced transportation problem –

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Computer Science and Engineering

B. TECH III– YEAR (VI Sem)

SUBJECT 3CS201

Advanced Engineering Mathematics

ASSIGNMENT 1

Answer all questions. Each question carries 5 marks

1. Explain the concept of random variable with examples. [CO-1]
2. What is mathematical expectation? Give example. [CO-1]
3. State the theorems on expectation. [CO-1]
4. What is spearman rank correlation? Find the rank correlation for the following data: [CO-2]

   The scores for nine students in physics and math are as follows:

   - Physics: 35, 23, 47, 17, 10, 43, 9, 6, 28
   - Mathematics: 30, 33, 45, 23, 8, 49, 12, 4, 31

   Compute the student's ranks in the two subjects and compute the Spearman rank correlation.

5. Solve the following problem: [CO-2]

   Patients arrive at a hospital accident and emergency department at random at a rate of 6 per hour.

   (a) Find the probability that, during any 90 minute period, the number of patients arriving at the hospital accident and emergency department is

   (i) exactly 7

   (ii) at least 10

   (5)

   A patient arrives at 11.30 a.m.

   (b) Find the probability that the next patient arrives before 11.45 a.m.

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Computer Science and Engineering

B. TECH III– YEAR (VI Sem)

SUBJECT 3CS201

Advanced Engineering Mathematics

ASSIGNMENT 2

Answer all questions. Each question carries 5 marks

1. What is optimization? [CO-3]
2. What are the application of optimization in engineering field ? [CO-3]
3. Consider the following N.L.P.P: [CO-4]

Minimize $Z=2x_1^2 -24x_1+2x_2^2-8x_2+2x_3^2-12x_3+200$

4. Show that the function is convex. Solve the problem by solving each one-variable function by calculus. [CO-4]
5. Solve the following LPP : [CO-5]

Maximize $Z = 3x_1 + 5x_2 + 4x_3 + 0s_1 + 0s_2 + 0s_3$

subject to the constraints

(i) $2x_1 + 3x_2 + s_1 = 8$, (ii) $2x_2 + 5x_3 + s_2 = 10$, (iii) $3x_1 + 2x_2 + 4x_3 + s_3 = 15$

and $x_1, x_2, x_3, s_1, s_2, s_3 \geq 0$

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VIVA-VOCE SET OF QUESTIONS

1) What are the applications of optimizations in engineering field ?
2) List the optimization techniques.
3) What do you mean by Random Variable?
4) Differentiate between continuous and discrete variable ?
5) What do you mean by Probability distribution function?
6) Explain binomial theorem.
7) What do you understand by the terms skewness and kurtosis?
8) Skewness measures_____of a give set of data?
9) What is the shape of Normal distribution?
10) In a Normal distribution N(_ , _)?
11) What do you understand by Exponential distribution?
12) What do you mean by mean deviations?
13) State the formula for correlation function?
14) When we need to apply spearman correlation coefficient?
15) List the steps involved in fitting of a straight line?
16) What do you mean by LPP?
17) What are the non-linear programming?
18) What are the application of transportation?
19) Explain the steps involved in solving the assignment problems?
20) Assignment problems are applied to a ___matrix?
21) Explain Langrangian theory?
22) what is the difference between a transportation and assignment problem?
23) $\mu 2$=_____?
24) $\beta_1 =$ _____
25) $r = \frac{\mu_{11}}{?}$?

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B. TECH III– YEAR (VI Sem)

SUBJECT 3CS201

Advanced Engineering Mathematics

QUIZ

Attempt all questions. Each question carries 1 mark. No negative marking. *Time – 15 mins*

1. There are 4 letters and 4 envelopes for them. If the letter are placed in the envelopes at random, what is the probability that all the letters are not placed in the right envelope.

a) 23/24

b) 2/5

c) both a) and b)

d) None of the above

2 Tossing a coin n times, is called

a) binomial trial

b) random trial

c) both a) and b)

d) Bernoulli trial

3. Skewness = -?

a) mean-mode

b) mean-median

c) neither a) nor b)

d) mean-3mode

4) Which of the terms are related to Kurtosis Peaked curve

a) Leptokurtic

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b) Mesokurtic

c) both a and b

d) None of these

5) $M_0(t) = ?$

a) $E(e^{-tX})$

b) generating functions

c) $E(e^{tX})$

d) None of the above

6) for a certain normal distribution the first moment about 10 is 40 and that the fourth moment about 50 is 48. What is the variance of the distribution?

a) 2

b) -1

c) Both a and b

d) None of the above

7) Degeneracy means_____?

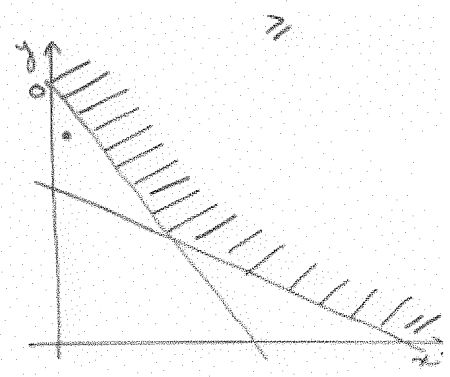
a) One or more of the basic variables are zero.

b) One must be a vector space.

c) Both a) and b)

d) None of the above

8) In the following figure, LPP has



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