

Name :  
Reg No :



APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY  
07 THRISSUR CLUSTER

FIRST SEMESTER M.TECH. DEGREE EXAMINATION DEC 2017

CHEMICAL ENGINEERING

PROCESS CONTROL

07MA6009

MATHEMATICS

Time:3 hours

Max.Marks: 60

Answer all six questions. Part 'a' of each question is compulsory.

Answer either part 'b' or part 'c' of each question

(Statistical tables are allowed.)

Q.no.	Module 1	Marks
1a	Show that the vectors $X_1 = (1,3,3)$ , $X_2 = (-1, 1, 2)$ and $X_3 = (1, 1, 1)$ form a basis for $R^3$ . With respect to this basis find the representation of the vector $(2,2,3)$	4
	<b>Answer b or c</b>	
b	In the space $P_2(t)$ of all polynomials in $t$ of degree at most 2 over $R$ , show that $\langle p, q \rangle = \int_{-1}^1 p(t)q(t)dt$ , $p, q \in P_2(t)$ is an inner product. Find an orthonormal basis for $P_2(t)$ using this inner product by Gramschmidt orthogonalization process.	5
c	Show that the following system of simultaneous equations has a unique solution. Hence find the solution by Gaussian elimination method. $3x - 2y + 5z + w = 1$ , $x + y - 3z = 2$ , $2x - y + z + w = 1$ , $x + 3z + 2w = 3$	5

Q.no.	Module 2	Marks
2a	Show that $\frac{d}{dx}[x^n J_n(x)] = x^n J_{n-1}(x)$	4
	<b>Answer b or c</b>	
b	Show that $P_n(x) = \frac{1}{2^n n!} \frac{d^n}{dx^n} [(x^2 - 1)^n]$	5
c	Reduce the following quadratic form into Canonical form by an orthogonal Reduction and hence determine its definiteness $3x^2 + 5y^2 + 3z^2 - 2xy - 2yz - 2zx$	5

Q.no.	Module 3	Marks
3a	Find regression line of Y on X from the following data. Use it to predict the value of Y when X = 5	4

X	1	4	6	8	10
Y	1	8	10	15	19

**Answer b or c**

- b Calculate the correlation coefficient between X and Y 5

X	8	1	5	4	7
Y	3	4	0	2	1

- c Solve the simultaneous equations 5

$$\frac{dx}{dt} + 5x - 2y = t$$

$$\frac{dy}{dt} + 2x + y = 0$$

Given  $x = y = 0$  when  $t = 0$ .

Q.no.	Module 4	Marks
4a	In a certain experiment, the error made in determining the specific gravity of a substance is a random variable having uniform density whose value lies in the interval $-(0.025, 0.025)$ . What is the probability that such error will be between 0.010 and 0.015?	4

**Answer b or c**

- b If the probability that an individual suffers a bad reaction from an injection is 0.001, find the probability that out of 2000 individuals (i) exactly 3 (ii) more than 2 individuals suffer from a bad reaction. 5
- c In a certain examination, the percentage of candidates passing and getting distinction were 60 and 10 respectively. Estimate the average marks obtained by the candidates if the minimum marks for pass is 40 and that for distinction is 80 respectively. Assume that the distribution of marks is normal. 5

Q.no.	Module 5	Marks
5a	A random sample of size 100 is taken from a population with standard deviation 5. If the sample mean is 21, construct a 95% confidence interval for the population mean.	5

**Answer b or c**

- b The manufacturer claims that the iron bar made by him has a mean breaking 7

strength of 180 kg. Five bars made by the same manufacturer are randomly chosen and found to have a mean breaking strength of 169 kg with a standard deviation of 5 kg. Can we accept the manufacturer's claim at 0.01 level of significance.

- c If 6 determinations of specific heat of iron have a standard deviation of 0.0086, test the standard deviation is 0.01 at 1% level of significance 7

Q.no.	Module 6	Marks
6a	Obtain the least squares fit of a straight line to the following data	5

X	0	1	2	3	4
Y	2	4	3	7	9

**Answer b or c**

- b The following are the number of mistakes made in 5 successive days for 3 technicians working for a photographic laboratory 7

Technician 1	6	14	10	8	11
Technician 2	14	19	12	10	14
Technician 3	10	12	7	15	11

Test at 1% level of significance whether the differences among the 3 sample means can be attributed to chance.

- c The measurements of breaking strengths of each of 3 kinds of linen threads by means of 4 different instruments are as follows 7

	Measuring Instrument			
	A	B	C	D
Thread 1	20	21	20	22
Thread 2	24	26	27	24
Thread 3	25	23	22	24

Perform an analysis of variance at 1% level of significance