



MANIPAL

A Constituent Institution of Manipal University FIRST SEMESTER M. TECH (MECHTRONICS ENGINEERING)

### END SEMESTER EXAMINATIONS, NOV/DEC 2017

## SUBJECT: MATHEMATICS FOR SIMULATION AND MODELLING

# [MAT- 5112]

### REVISED CREDIT SYSTEM (28 / 11 / 2017)

Time: 3 Hours

MAX. MARKS: 50

#### Instructions to Candidates:

✤ Answer ALL the questions.

1A.	The data below represents the bacterial growth in a liquid culture over of number of											
	days. Fit a curve $y = a e^{bx}$ for the following data and also find the amount of											
	Bactria after 20 days											
	Day	0	2	4	6	8	10	12	14	16		
	Amount	67.38	70.93	74.67	78.60	82.74	87.10	91.69	92.5	1 101	1.60	
	$\times 10^{6}$											4
1B.	Explain 15 characteristics of mathematical modeling.										3	
1C.	i)Using the Z-transform. Solve $v_{1} + 4v_{2} + 3v_{3} = 3^{n}$ with $v_{0} = 0$ , $v_{1} = 1$ .											
	$y_{n+2} = y_{n+1} = y_n$ $y_n = y_{n+1} = y_n$											
	ii) Find the 7 transform and region of convergence of $u(n) = \int 4^n for n < 0$											
	1) Find the Z-transform and region of convergence of $u(n) = \begin{cases} 2^n & \text{for } n \ge 0 \end{cases}$											3
2A.	Use multiple linear regression to fit following date's and hange compute correlation											
	$coefficient between V and X_1$											
	X <sub>1</sub>	0	1	1	2	2	3	3	4	4		
	X <sub>2</sub>	0	1	2	1	2	1	2	1	2		
	Y	15	18	12.8	25.7	20.6	35.0	29.8	45.5	40.3		4
JD	A lake contains 10000 fish at present If there was no fishing the provide in a fishing											
<b>ZD</b> .	A lake contains 10000 fish at present. If there was no fishing the population of fish											
	would increases by 15% every year. It is proposed to allow fishing at the rate of 2000											
	fish per year. Develop the Mathematical Model for the problem and find how long it											
	will take for the population of fish decreases to zero											
	will take for the population of fish decreases to zero.											2
												5

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2C.	A breeder reactor converts the relatively stable uranium 238 into the isotope										
	plutonium 239. After 15 years it is found that 0.043 percent of the initial amount $A_0$										
	of the plutonium has disintegrated. Find the half-life of this isotope, if the rate of										
	disintegration is proportional to the remaining amount.										
3A.	The following system is a prey-predator model in which human harvesting occurs for both species. Use Euler's method with step size $\Delta t = 1$ over $0 \le t \le 3$ to numerically $dx = 3$ $dy = 3$										
	solve $\frac{dx}{dt} = x - xy - \frac{3}{4}y$ , $\frac{dy}{dt} = xy - y - \frac{3}{4}x$ subject to $x(0) = 1/2$ , $y(0) = 1$ .	4									
3B.	Obtain the model for one dimensional Heat equation and hence find the solution by using variable separable method.										
3C.	Explain the susceptible –Infected –susceptible model.										
4A.	A tightly stretched string with fixed end points at $x = 0$ and $x = l$ is initially in its equilibrium position and it is set vibrating by giving to each of its points a velocity i.e $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 3(lx - x^2)$ and $u(x,0) = 0$ . Find the displacement $u(x,t)$ .										
4B.	Obtain model for motion of projectile and hence obtain time of flight, maximum height, and range and express the path of projectile in parabolic form.										
4C.	A spring is such that 2 <i>lb</i> weight stretches a certain spring 6 inches. An impressed $\frac{1}{4} \sin 8t$ force $\frac{1}{4} \sin 8t$ is acting upon on the spring. If the 2 <i>lb</i> weight pulled 3 inches below the equilibrium position and released, determine the equation of motion.										
5A.	For conducting a practical examination the chemistry department of the college requires 10, 12 and 7 units of chemicals x, y and z respectively. The chemicals are available in two types of boxes A and B. Box A contains 3, 2 and 1 units of x, y and z respectively and costs Rs 300. Box B contains 1, 2 and 2 units of x, y and z respectively and costs Rs 200. Find how many box of each type should be bought by the department so that total cost is minimum. Solve by graphical method.										
5B.	Solve the following L. P.P by simplex method Max $Z = x_1 + 9x_2 + x_3$ Subject to $x_1 + 2x_2 + 2x_3 \le 9$ , $3x_{1+}2x_2+2x_3 \le 15$ , $x_1, x_2, x_3 \ge 0$	3									

