RAMAIAH UNIVERSITY OF APPLIED SCIENCES

Faculty of Science and Humanities			
Ramaiah University of Applied Sciences			
Department	Mathematics	Programme	B. Tech.
Semester/Batch	2/2017		
Course Code	BSC104A	Course Title	Engineering Mathematics – 2
Course Leader(s)	Deepak A. S., Chandankumar S., Shekar M., Hemanthkumar B., Sumanth Bharadwaj H.S. Venu K. and Mahadev Channakote		

Assignment – 01			
Reg. No.		**Name of Student**	

Sections		Marking Scheme	Max Marks	First Examiner Marks	Moderator
Part-A	A.1	Explanation of Lagrange and Newton bivariate interpolation with example	4		
	A.2	Comparison between above interpolations	2		
	A.3	MATLAB function for the Lagrange bivariate interpolation	4		
		Part-A1 Max Marks	10		
Part B 1	B.1.1	Formation of ODE and its solution	5		
	B.1.2	Time required for the lake to become pollutant free	1		
	B.1.3	Plot of Q(t) versus time	2		
	B.1.4	Time required for pollutants to become thrice and one tenth of the initial quantity	2		
		Part-B1 Max Marks	10		
Part B 2	B.2.1	ODE and solution	5		
	B.2.2	Time required to repay the loan completely	2		
	B.2.3	Amount of loan paid after 10 years and 15 years	2		
	B.2.4	Comments and conclusion	1		
		Part-B2 Max Marks	10		
Part B 3	B.3.1	MATLAB function for polynomial using NGFIF	4		
	B.3.2	Speed for each listed time	2		
	B.3.3	Maximum speed of the horse	2		
	B.3.4	Plot of the distance and speed curve	2		
		Part-B3 Max Marks	10		
Part B 4	B.4.1	MATLAB function for Lagrange interpolation	6		
	B.4.2	Prediction of population at 1997 and 2008.	2		
	B.4.3	Plot of the number of polio affected children verses year	2		
		Part-B 4 Max Marks	10		
		Total Assignment Marks	**50**		

Course Marks Tabulation				
Component-1 (B) Assignment	**First Examiner**	**Remarks**	**Moderator**	**Remarks**
A				
B.1				
B.2				
B.3				
B.4				
Marks (Max 50)				
Marks (out of 25)				
Signature of First Examiner			**Signature of Moderator**	

Please note:

1. Documental evidence for all the components/parts of the assessment such as the reports, photographs, laboratory exam / tool tests are required to be attached to the assignment report in a proper order.
2. The First Examiner is required to mark the comments in RED ink and the Second Examiner's comments should be in GREEN ink.
3. The marks for all the questions of the assignment have to be written only in the **Component – CET B: Assignment** table.
4. If the variation between the marks awarded by the first examiner and the second examiner lies within +/- 3 marks, then the marks allotted by the first examiner is considered to be final. If the variation is more than +/- 3 marks then both the examiners should resolve the issue in consultation with the Chairman BoE.

Assignment – 01
Term - 1

Instructions to students:

1. The assignment consists of **5** questions: Part A – **1** Question, Part B- **2** Questions.
2. Maximum marks is **50**.
3. The assignment has to be neatly word processed as per the prescribed format.
4. The maximum number of pages should be restricted to **20**.
5. Restrict your report for Part-A to 3 pages only.
6. Restrict your report for Part-B to a maximum of 17 pages.
7. All the graphs should be plotted using MATLAB with appropriate title and axes labels. Append MATLAB code.
8. The printed assignment must be submitted to the course leader.
9. **Submission Date: 12/03/2018**
10. **Submission after the due date is not permitted.**

11. **IMPORTANT**: It is essential that all the sources used in preparation of the assignment must be suitably referenced in the text.
12. Marks will be awarded only to the sections and subsections clearly indicated as per the problem statement/exercise/question

Preamble

This course deals with analytical solutions of ordinary differential equations apart from the data modelling techniques. Students are taught the concepts of order, degree, linearity, homogeneity, classification, standard forms and the associated analytical solution of differential equations. The role, relevance of ordinary differential equations in modelling some of the real world problems are also emphasized. The significance and importance of data modelling in applied engineering problems and solution of ordinary differential equations arising some real world problems are discussed with the help of mathematical tool MATLAB.

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Part-A (10 Marks)

Interpolation produces a function that matches the given data exactly. The function then can be utilized to approximate the data values at intermediate points. Bilinear interpolation is an extension of a function of one variable to a function of two variables, which has applications in modelling of real world data.

Write an essay on **"Bivariate interpolation"**. Your report should include the following:

A.1.1. Detailed explanation of Lagrange and Newton's bivariate interpolations with an example.

A.1.2. Comparison between the interpolations mentioned in **A.1.1.**

A.1.3. MATLAB function to determine the two variable polynomial using Lagrange bivariate interpolation for any considered data.

Part B (40 Marks)

B.1. (10 Marks)

Bellandur lake in Bengaluru has $50{,}00{,}000\ \mathrm{m}^3$ of water with 25000 tons of dissolved pollutants. A Sewage Treatment Plant (STP) near the lake stops working and the sewage water containing $40\ \mathrm{kg/m}^3$ of pollutants enter the lake at a rate of $20800\ \mathrm{m}^3/\mathrm{hour}$. Meanwhile a nearby industry starts discharges its waste water to the lake, containing $50\ \mathrm{kg/m}^3$ of pollutants at a rate of $200\ \mathrm{m}^3/\mathrm{hour}$. Assume that the pollutants are uniformly mixed before the water leaves the lake at a rate of $21000\ \mathrm{m}^3/\mathrm{hour}$. After 5 days, fresh water without any pollutants flows into the lake at a rate of $15000\ \mathrm{m}^3/\mathrm{hour}$. At the same time, the STP starts working and the industry stops discharging its waste water into the lake. The water leaves the lake at the previous rate of $21000\ \mathrm{m}^3/\mathrm{hour}$.

Let $Q(t)$ denote the amount of pollutants present in the lake at any time t.

B.1.1. Form a first order differential equation for $Q(t)$ and obtain an expression for the same by solving your model manually.

B.1.2. Determine the time required for the lake to become pollutant free.

B.1.3. Plot a graph of t versus $Q(t)$ from $t = 0$ to the time when there are no pollutants.

B.1.4. Determine the time at which the quantity of pollutants become thrice the initial quantity and one tenth of the initial quantity.

B.2. **(10 Marks)**

A man purchases a home by making a bank loan of Rs 50,00,000 at an interest rate of 8.5% per annum. He expects to make repayments at a monthly rate of $40000(1 + t/120)$, where t is the number of months since the loan was made. Let $S(t)$ denote the amount debt at any time t and assume that the compounding takes place continuously.

B.2.1. Obtain a first order ODE describing the above process and solve for $S(t)$.

B.2.2. Assuming that the repayment schedule is maintained, determine the time required to repay the loan completely.

B.2.3. Determine the amount of loan paid after 10 years and 15 years. Comments and conclusion.

B.3. **(10 Marks)**

A horse named Vayujit running in a derby along a straight path is clocked at a number of points. The data from the observations are given in the following Table 1, where time is in seconds, the distance is in meters.

Time	0	3	6	9	12	15
Distance	0	58	122	196	216	370

Table 1

B.3.1. Write a MATLAB function to determine the interpolating polynomial using Newton Gregory forward interpolation. Hence predict the position of the horse at $t = 10$ s.

B.3.2. Predict the speed at each time listed, using the given times and positions.

B.3.3. Predict the maximum speed of the horse in $1 \leq t \leq 10$.

B.3.4. Plot the distance and speed curve in the interval $0 \leq t \leq 15$.

B.4. **(10 Marks)**

During early 90's eradication of polio virus was one of the biggest challenge for India. But in 1994 India introduced oral poliovirus vaccine(OPV) in the expand programm on immunization(EPI) in 1979. As a result of OPV the polio virus case gradually decreased and since January 13, 2011 there was no cases of polio was recorded. The population of polio affected children from 1995 to 2009 are given in Table 2.

Year	1995	1996	1999	2003	2005	2009
Population	3300	1000	1200	220	85	720

Table 2

B.4.1. Write a MATLAB function to obtain an interpolating polynomial using Lagrange interpolation for the given data.

B.4.2. Calculate the number of polio affected children in the year 1997 and 2008.

B.4.3. Plot the number of polio affected children verses year for the given data with interpolating polynomial.