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١٦/٦/٢٠١٥م

Menoufia University
Faculty of Engineering, Shebin El-Kom
Mechanical Power Engineering Department

Second Semester Examination, 2014-2015
Date of Exam: 6/6/2015

Minufiya University

Course Title: Numerical Methods in Mechanical Power Engineering
Course Code: MPE 322
Level: Third Year-Power
Duration: 3 hours
Total Mark: 90 marks

Remarks: No. of pages: 2   No. of questions: 5   Allowed Tables and Charts: *None*
PLEASE USE THE ANSWER BOOKLET WISELY

Answer ALL the Following Questions (Assume any missing data)

(Question 1) :(15 Marks)

1-a) (4 marks)
Draw a sketch to explain the numerical integration using Newton Cote's open formula when two segments and three segments are used in calculations.

1-b) (11 marks)
Compute the numerical integral for the data listed in the Table below using the Simpson's rules for those segments where they are appropriate

x	0.00	0.12	0.22	0.32	0.36	0.40	0.44	0.54	0.64	0.70	0.80
f	0.4000	2.6195	2.6105	3.4868	4.1498	4.9120	5.6860	7.0146	6.3639	4.7260	0.4640

(Question 2): (25 Marks)

2-a) (5 marks)
Explain using a drawing how the shooting method is used to replace the boundary value problem by two initial value problems when solving an ordinary differential equation.

2-b) (20 marks)
Use the Linear Shooting method to approximate the solution to the following boundary-value problem

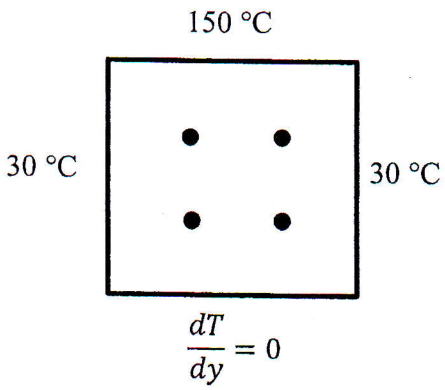
$y'' = -3y' + 2y + 2x + 3$ $0 \le x \le 1$ $y(0)=2$ $y(1)=1$ $h=0.5$

Use the fourth order Runge-Kutta method where appropriate.

(Question 3): (15 Marks)

A heated plate is divided into 2 by 2 inner nodes at equal increments in both x and y directions. The upper boundary is at 150 °C and the lower boundary is insulated. The other two sides are kept at 30 °C as shown in the opposite figure. Use Liebmann's method to solve the Laplacian equation for the temperature of the square heated plate. Use a relaxation factor of 1.2 and iterate to ε = 5% or until a maximum iteration number of 2 is reached.

Use zero values for initial approximation of inner temperatures



(Question 4) :(20 Marks)

Use the implicit BETA formulation method (forward time, weighted average central space difference) to solve the following unsteady one-dimensional heat diffusion equation with β=0.8

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

The plate thickness L = 1.0 cm and thermal diffusivity $\alpha = 0.01$ cm^2/s.
The plate is heated to an initial temperature distribution, T(x, 0), at which time the heat source is turned off. The initial temperature distribution in the plate is specified by

$T(x, 0) = 200.0x \qquad 0.0 \le x < 0.5$

$T(x, 0) = 200.0(1-x) \qquad 0.5 \le x \le 1.0$

where T is measured in degrees Celcius (°C). The temperatures on the two faces of the plate are held at 0.0 °C for all times. Thus, T(0.0, t) = T(1.0, t) = 0.0
The temperature distribution within the plate, T(x, t), is required at t=0.5 s for Δx=0.2 cm and Δt=0.5 s.

(Question 5) :(15 Marks)

Starting from Taylor series expansion, solve the first order wave equation

$$\frac{\partial u}{\partial t} = -2\frac{\partial u}{\partial x} \qquad 0.0 \le x \le 10.0$$

by using the explicit Lax Wendroff's approximation if Δx=2.0 and Δt=0.5.
The boundary and initial conditions are:
u(0,t)=30 °C , u(10,t)=90 °C and u(x,0)=20+5x
Find the temperature distribution at t=1.0 s.

This exam measures the following ILOs									
Question Number	Q1-a	Q2-a	Q3, Q4, Q5	Q3, Q4, Q5	Q3, Q4, Q5	Q3, Q4, Q5	Q2-b	Q3, Q4, Q5
Skills	a2-2	a2-2	b11-2	b2-3	b2-1	b11-1	C6-1	C6-1 , C15-1
	Knowledge &Understanding Skills		**Intellectual Skills**				**Professional Skills**	