P346 Computer Lab

Mid-Semester examination, 2021

NISER, Bhubaneswar

Full marks: 15 Time: 1.5 hours

Marks are given in bold along with the questions. Attempt all.

1. Wein's displacement law states that black body radiation for different temperatures peak at different wavelengths (λ_m) that are inversely proportional to the temperature T, *i.e.* $\lambda_m T = b$, where b is Wein's constant. It can be derived from the Planck's law for spectrum of black body radiation by solving

$$(x-5)\,e^x + 5 = 0, \quad \text{where } x = \frac{hc}{\lambda_m kT} > 0$$

Solve the above equation using Newton-Raphson method and determine Wein's constant b in meter-Kelvin to a precision of 10^{-4}. Take $h = 6.626 \times 10^{-34}\, m^2 - kg/s$, $k = 1.381 \times 10^{-23}\, m^2 - kg/Ks^2$ and $c = 3 \times 10^8\, m/s$. **[2+1=3]**

2. Find the inverse, (check) if it exists, of the following matrix using Gauss-Jordan elimination, **[2+2=4]**

$$\begin{pmatrix} 0 & 0 & 0 & 2 \\ 0 & 0 & 3 & 0 \\ 0 & 4 & 0 & 0 \\ 5 & 0 & 0 & 0 \end{pmatrix}$$

3. Solve the following set of linear equation using LU decomposition **[3+1=4]**

$$\begin{aligned} 3x_1 - 7x_2 - 2x_3 + 2x_4 &= -9 \\ -3x_1 + 5x_2 + x_3 &= 5 \\ 6x_1 - 4x_2 - 5x_4 &= 7 \\ -9x_1 + 5x_2 - 5x_3 + 12x_4 &= 11 \end{aligned}$$

4. Find a real root of the following equation correct upto four decimal places in the interval [0,1] using both Midpoint and Regula-falsi method,

$$4e^{-x}\sin x - 1 = 0$$

Compare the convergence of the two methods. **[2+2=4]**