BANKURA UNIVERSITY

B.Sc. 1st Semester (Honours) Examination, March 2021

Subject: *Electronics (H)*

Course ID: 11712 **Course Code: SH/ELC/102/C-2(TH)**

Course Title: *Mathematics Foundation for Electronics*

Full Marks: 25 **Time: 1 Hr 15 Min**

(The figures in the right hand side margin indicate marks.
Answer all the questions)

1. Answer *any three* of the following questions 1×3=3
   a) What do you mean by differential equation?
   b) Give one example of partial differential equation of second order.
   c) Express the complex number $Z = 2 + 2\sqrt{3}i$ in polar form (r, Θ).
   d) Show that $V(x, y) = 3x^2y - y^3$ is a harmonic function.
   e) What is a 'singular' point?
   f) What is recurrence relation?

2. Answer *any three* of the following questions. 2×3=6
   a) What is the relation between Beta and Gamma functions?
      Show that $\Gamma(n+1) = n\Gamma(n) = n!$
   b) What is an analytic function?
   c) Locate and name all the singularities of $f(z)=\frac{Z^8+Z^4+2}{(Z-1)^3(3Z+2)^2}$ in the finite Z-plane.
   d) What are the necessary and sufficient conditions for the functions $f(z) = w(x, y) = u(x, y) + iv(x, y)$ to be analytic at all points in a region R bounded by the curve C?
   e) Find the point where the Cauchy–Riemann equations are satisfied for the function $f(z) = w = xy^2 + ix^2y$.
   f) $\beta(m+1,n)=\frac{m}{m+n}\beta(m,n)$ – Prove this from the definition.

3. Answer *any two* of the following questions. 5×2=10

a) Show that the polar forms of Cauchy–Riemann (C-R) equations are

$$\frac{\partial u}{\partial r}=\frac{1}{r}\frac{\partial v}{\partial \theta}\ ,\ \frac{\partial v}{\partial r}=\frac{-\partial u}{\partial \theta}.$$

b) Using the method of separations of variables find the general solution of the equation.

$$\frac{\delta^2 y}{\delta t^2}=c^2\frac{\delta^2 y}{\delta x^2}.$$

c) Find the value of the integral

$$\mathrm{I} = \oint_C \frac{Z^2}{Z^2-1}dz,$$

around the unit circle with centre at (i) $z = -1$ and (ii) $z = 1$.

d) Construct the recurrence relation by solving the given differential equation by Frobenious power series method:

$$(1-x^2)\frac{d^2 y}{dx^2}-2x\frac{dy}{dx}+2y=0.$$

4. Answer *any one* of the following questions. 6×1=6

a) What is Argand's diagram? Draw the Argand's diagram for a complex number $Z=x+iy$. State Residue Theorem. Discuss the various methods of calculation of Residue. 1+1+2+2

b) Find the characteristics roots and eigen vectors of the matrix

$$A=\begin{bmatrix}2 & 0 & 1\\ 0 & 2 & 0\\ 1 & 0 & 2\end{bmatrix}.$$

c) The given differential equation is

$$x^2\frac{d^2 y}{dx^2} + 4x\frac{dy}{dx} + (x^2+2)y=0.$$

Solve it by power series method upto the construction of the 'indicial' equation.
