

Sardar Vallabhbhai National Institute of Technology, Surat

B.Tech.-I (Semester-II)

Mid Semester Examination- May 2021

Sub: MA 114 S2 Mathematics-II

Date: 17-05-2021

Time: 09.30 am to 11.30 am

Total Marks: [30]

(1 Hour 30 Minutes for writing and 30 minutes for uploading answer sheets)

General Instructions

- (i) There are total **THREE** questions in the question paper.
 - (ii) All questions are compulsory.
 - (iii) Figure to the right indicates marks.
 - (iv) Follow usual notations.
 - (v) All must write your Admission Number, Role Number, Mobile Number, email on TOP of first page of answer sheet and admissions number and page no. with your signature on all pages.
 - (vi) **Important Instructions: Students must upload their answer sheet (single PDF file) on Google classroom or Microsoft team as per your class teacher suggestion latest by 11.30 AM on same day.**
 - (vii) **First verify the number of pages in your PDF file and then upload. Once you upload the file then after we will not consider any updated file.**
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1 Answer the following questions with justification.

[10]

- (1) The brewing pot temperature of coffee is 180°F . and the room temperature is 76°F . After 5 minutes, the temperature of the coffee is 168°F . How long will it take for the coffee to reach a serving temperature of 155°F .?
- (2) Solve by method of variation of parameter $(D^2 + 1)y = \operatorname{cosec} x \cot x$.
- (3)
 - (a) In usual notation, epidemic spread susceptible Infected (SI) model governing equation is given by $\frac{dI}{dt} = \beta IS$. What is the physical meaning of $\beta > 0$ and $\beta < 0$ in this model?
 - (b) In SI (Susceptible-Infected) model, after long time, $(t \rightarrow \infty)$, $I(t) = \dots\dots\dots$?
- (4) Solve $(D^2 - 4D + 3)y = \sin 3x \cos 2x$.
- (5) Consider the equation $x(x+1)^2 y'' + (2x-1)y' + x^2 y = 0$ Show that $x=0$ is regular singular point and $x=-1$ is irregular singular point of the equation.

2 (A) Solve $(D^2 - 4)y = \cosh(2x - 1) + 3^x$.

OR

[02]

(A) Solve $(3x+2)^2 y'' + 3(3x+2)y' - 36y = 3x^2 + 4x + 1$

(B) Answer the following questions (Attempt any two)

[04]

- (1) Solve $(D^2 - 4D + 3)y = 2x e^{2x} + 3e^x \cos 2x$.
- (2) Solve $\{3y - 2xy^3\}dx + \{4x - 3x^2 y^2\}dy = 0$.
- (3) Solve $y = 2px + yp^2$.

- (C) Find the indicial equation of $(x-x^2)y'' + (1-x)y' - y = 0$ at $x=0$ regular singular point.

[02]

3 (A) Solve $(1 - x^2)y'' + 2xy' - y = 0$ at ordinary point $x = 0$.

[06]

OR

(A) Solve $2x^2y'' - xy' + (x^2 + 1)y = 0$ at $x=0$ regular singular point.

(B) Attempt any two

[06]

- (1) A condenser of capacity C is discharged through L and a resistance R in series and charge q at any time t given by the equation $Lq'' + Rq' + \frac{q}{C} = 0$. If $L=0.5$ henry, $R= 300$ ohms, $C= 2 \times 10^{-6}$ farad and also when $t = 0$, charge $q = 0.01$ and current $q'=0$, find the value of q in terms of t .
- (2) The differential equation satisfied by a beam uniformly loaded with one end fixed and the second end subject to the tensile force P is given by $E I y'' = P y - \frac{1}{5} Wx^2$ with conditions $y' = y = 0$ at $x = 0$. Find the deflection curve y .
- (3) A 4000 liter tank of water initially contains 20 kg of dissolved salt. A pipe brings salt solution with concentration 0.02 kg/liter in to the tank at the rate 2 liter/second and a second pipe carries away the excess solution at the same rate. Calculate concentration of salt at $t= 5, 10, 15$ second with assumption that tank is well mixed.

END
