

**VIT**

Vellore Institute of Technology

(Autonomous Institute of Technology - Vellore, Tamil Nadu - 620 015)

**DEPARTMENT OF MATHEMATICS****SCHOOL OF ADVANCED SCIENCES**

Fall Semester – 2019 ~ 2020

Continuous Assessment Test – II, October- 2019

Course Code : MAT2002

Course Name : Applications of Differential and Difference Equations

Max. Marks : 50

Slot : F2

Duration: 90 Minutes

**ANSWER ALL QUESTIONS**

1. A vibrational system consisting of mass  $m = \frac{1}{5}$  kg attached to a spring  $k = 2$  N/m. The mass is released from rest  $\frac{1}{2}$  meter below the equilibrium position. The motion is damped with velocity 1.2 and is being driven by an external periodic force beginning at  $t = 0$ . Intuitively we would expect that even with damping the system would remain in motion until such time as forcing function was  $f(t) = 5 \cos 4t$  will remain "on". Solve for the equation of motion by method of undetermined coefficients. (10)[CO3]
2. Solve  $((x+1)^2 D^2 + (x+1)D + 1)y = 4 \cos \log(x+1)$ . (10)[CO3]
3. Consider a series RLC circuit where  $R = 20 \Omega$ ,  $L = 0.05$  H and  $C = 10^{-4}$  F and is driven by an alternating emf given by  $E = 100 \cos 200 t$ . Given that both the circuit current  $i$  and the capacitor charge  $q$  are zero at  $t = 0$ , find an expression for  $i(t)$  in the region  $t > 0$ . (10)[CO3]
4. Two 1000 liter tanks are with salt water. Tank 1 contains 800 liters of water initially containing 20 grams of salt dissolved in it and tank 2 contains 1000 liters of water and initially has 80 grams of salt dissolved in it. Salt water with a concentration of  $\frac{1}{2}$  gram/liter of salt enters tank 1 at a rate of 4 liters/hour. Fresh water enters tank 2 at a rate of 7 liters/hour. Through a connecting pipe water flows from tank 2 into tank 1 at a rate of 10 liters/hour. Through a different connecting pipe 14 liters/hour flows out of tank 1 and 11 liters/hour are drained out of the pipe (and hence out of the system completely) and only 3 liters/hour flows back into tank 2. Set up the system that will give the amount of salt in each tank at any given time and solve it. (10)[CO3]
5. Find the power series in  $x$  for the general solution of  $(1 + 2x^2)y'' + 6xy' + 2y = 0$ . (10)[CO4]

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