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BCS405C

Fourth Semester B.E./B.Tech. Degree Examination, June /July 2026 Optimization Technique

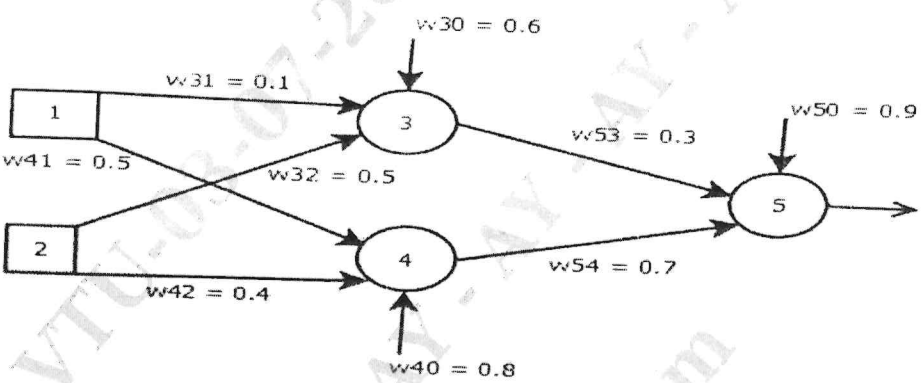
Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.*

Module – 1				M	L	C
Q.1	a.	Let $f(x_1, x_2) = x_1^2 + 2x_2^2$ where $x_1 = \sin t$, $x_2 = \cos t$. Find $\frac{df}{dt}$. Also find its gradient and matrix size.	07	L2	CO1	
	b.	If $z = x^2y + xy^2$, $x = at$, $y = 2at$ find $\frac{dz}{dt}$.	06	L2	CO1	
	c.	If $Z = x^2 + y^2$, $x = e^u \sin v$, $y = e^u \cos v$. Find $\frac{\partial z}{\partial u}, \frac{\partial z}{\partial v}$	07	L2	CO1	
OR						
Q.2	a.	Find the Jacobian determinant of $y_1 = x_1^2 + x_2^2 + x_3^2$, $y_2 = x_1x_2 + x_2x_3 + x_3x_1$, $y_3 = x_1 + x_2 + x_3$	07	L2	CO1	
	b.	Obtain the gradient of vector $f = [e^{x_0x_1} \ e^{x_2x_3}]$ with respect to the matrix $\begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$.	06	L2	CO1	
	c.	Obtain the gradient of scalar $y = x_0 + x_1 + 4x_2 - 6x_3$ with respect to the matrix $\begin{bmatrix} x_0 & x_1 \\ x_2 & x_3 \end{bmatrix}$	07	L2	CO1	
Module – 2						
Q.3	a.	Assume that the neuron have sigmoid activation function. Perform a forward pass and backward pass on the network. Assume that the actual output of y is 0.5 and learning rate is 1. Perform another forward pass and write the given network also.	10	L3	CO2	
		Fig. Q 3 (a)				
	b.	Draw a computational graph of the function. $f(x) = \sqrt{x^2 + e^{x^2}} + \cos(x^2 + e^{x^2})$ Also find $\frac{df}{dx}$ by using automatic differentiation.	10	L3	CO2	

OR

Q.4	a.	If $f = x^2 (x + y)$ where $c = x^2$, $s = x + y$ i) Draw a computational graph ii) $\frac{df}{dx}$, $\frac{df}{dy}$ using Chain rule. iii) Draw a computational graph in forward mode to show the results of $\frac{df}{dx}$ and $\frac{df}{dy}$.	10	L3	CO2
	b.	Find output at neuron 5 if input vector is $[0.7, 0.3]$ using the activation function ReLu.  Fig. Q.4 (b)	10	L3	CO2

Module – 3

Q.5	a.	Write the differences between Local and Global optima.	08	L2	CO3
	b.	Minimize $f(x) = x^2$ over $[-5, 15]$ using Fibonacci search by taking $n = 7$.	12	L3	CO3

OR

Q.6	a.	Using three point interval search method, find the maximum of $f(x) = x (5\pi - x)$ over $[0, 20]$ with $\epsilon = 0.1$	12	L2	CO3
	b.	Define convex and Non-convex function. Importance of convexity in machine learning.	08	L3	CO3

Module – 4

Q.7	a.	Use N – R method to approximate $f(x) = x^2 + \frac{54}{x}$, $x_0 = 2.8$, $\epsilon = 10^{-4}$	10	L3	CO4
	b.	Write the differences between stochastic gradient descent method and Minibatch gradient descent method.	10	L2	CO4

OR

Q.8	a.	Minimize $f(x) = 3x_1^2 + 4x_2^2 + 5x_3^2$ subject to the condition $x_1 + x_2 + x_3 = 10$.	10	L3	CO4
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	b.	Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1 x_2 + x_2^2$, starting from $x_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ using steepest descent method.	10	L3	CO4
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Module – 5

Q.9	a.	Explain in brief: i) Adagrad optimization strategy ii) RMS Prop	07	L2	CO5
	b.	What is the difference between Convex Optimization and Non – Convex Optimization?	07	L2	CO5
	c.	Describe the saddle point problem in machine learning.	06	L2	CO5

OR

Q.10	a.	Write short notes on : i) Stochastic gradient descent with momentum. ii) ADAM	07	L2	CO5
	b.	What is the best optimization algorithm for machine learning?	07	L2	CO5
	c.	Briefly explain the advantage of RMS Prop over Adagrad.	06	L2	CO5
