EC364TA

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RV COLLEGE OF ENGINEERING
Autonomous Institution affiliated to VTU
VI Semester B.E. July/Aug-2025 Examinations
Department of Electronics and Communication Engineering
DIGITAL SIGNAL PROCESSING & MACHINE LEARNING
Model Question Paper
(2022 SCHEME) (Common to EC & EI)

Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

1. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
2. Answer FIVE full questions from Part B. In Part B question number 2 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, and 9 and 10.

		PART-A	M
1	1.1	Find the order of a butter worth filter which had -0.91dB pass band attenuation at a frequency of 1.099 rad/sec and at least -11.21dB stop band attenuation at frequency of 2.198rad/sec.	2
	1.2	For the fifth order Butterworth LPF, If the passband gain =1dB at pass-band frequency of 4rad/sec. Find the value of stopband attenuation in dB at the stopband frequency of 8rad/sec.	2
	1.3	Find the cutoff frequency of third order Low pass Butterworth which had -11.21dB stop band attenuation at stop band frequency of 2.198rad/sec.	1
	1.4	Find $\lvert H(w) \rvert$ for the sequence h(n) = 1, 0, 1 at w = π for Type 1 FIR filter.	1
	1.5	For a given analog low-pass (maximally flat) filter that will have a -1dB cutoff frequency at 75 HZ and have greater than 20dB of attenuation for all frequency greater than 150 Hz. Find order of filter.	1
	1.6	In Bilinear transformation if Ω=1 maps to ω=π/2, Ω=2 maps to _____value of ω.	1
	1.7	If in the below logistic function, b0 is -9.346 and b1 is 0.014634 the predicted value for x1 = 721 would be _____. $\hat{\pi}_i = \frac{e^{b_0 + b_1 X_1}}{1 + e^{b_0 + b_1 X_1}}$	2
	1.8	Irrespective of the relation between x (input) and y(output) being linear or non linear, the sum of residuals are always _____.	1
	1.9	Estimation of _____ error of a ML model is done by measuring performance on a test set that were collected separately from the training set.	1

	1.10	Machine Learning algorithms will perform well when there _____ is appropriate for the true complexity of the task that they need to perform and the amount of training data they are provided with.	1
	1.11	An ML model with high _____ captures the complexity of the true relationship between x and y; but it would not make accurate predictions on unseen data.	1
	1.12	As _____ of a given ML model increases, bias tends to decrease and variance tends to increase.	1
	1.13	The variance of a data is 2, Correlation between data sets is 0.1. If ten trees are used , what is the average variance in case of random forest as a classifier?	1
	1.14	In a list of 14 examples including 9 positive and 5 negative examples. The gini impurity of the data set with respect to this classification is _____.	1
	1.15	Which deep learning architecture has been particularly effective in computer vision tasks like image classification and object detection?	1
	1.16	Which type of RNN architecture is well-suited for tasks like image captioning and music generation?	1
	1.17	What is the main function of the Input Gate in LSTM networks?	1
		PART-B	
2	A	Convert the analog filter with system function $H(s) = \frac{(S+0.1)}{(S+0.1)^2+(4)^2}$ Into a digital IIR filter by mean of the bilinear transformation. The digital filter is to have a resonant frequency of $w_r = \pi/2$.	10
	b	An digital lowpass filter is required to meet the following specifications: Passband ripple < 01dB Passband edge : 4kHZ Stopband attenuation ≥40dB Stopband edge : 6KHZ Sample rate : 24KHZ Determine the required filter order for (i)A Digital Butterworth filter (ii) A Digital Chebyshev filter, using bilinear transformation on an analog system function.	6
3	a	A low pass filter is designed to obtain the following frequency response: $H_d(w) = \begin{cases} e - j2w & \lvert w\rvert \le \pi/4 \\ 0 & \pi/4 < \lvert w\rvert < \pi \end{cases}$ Calculate the filter coefficient $h_d(n)$ and h(n) if w(n) is the rectangular window of length 5.	10
	b	Obtain the coefficients of an FIR filter to meet the specifications given below using the window method.	06

		Passband edge frequency : 1.5 KHz Stopband edge frequency : 2 KHz Minimum stopband attenuation : 50 dB Sampling frequency : 8 KHz	
		OR	
4	a	The desired frequency response of a lowpass filter is $H(w) = e^{-j3w}$, $\|w\| < 3\pi/4$ 0, otherwise Determine the frequency response of the FIR filter if Hanning window is used with N = 7.	10
	b	An analog signal contains frequencies upto 10KHz. This signal is sampled at 50 KHz. Design an FIR filter having a linear phase characteristic and transition band of 5 KHz. The filter should provide minimum 50 dB attenuation at the end of transition band.	06
5	a	Compare i) Supervised and unsupervised ii) Classification and Regression with examples	6
	b	With necessary hypothesis and cost function show how the parameters of multivariate linear regression can be computed using gradient descent algorithm.	6
	c	Compare Least squares and Maximum likelihood estimators for regression.	4
		OR	
6	a	What is the significance of logit function? How does logit of a linear multivariate regression equation map the $-\infty$ to $+\infty$ to -1 to +1? Illustrate with suitable example	8
	b	The sales of a company (in million dollars) for each year are shown in the table below. x (year): 2015, 2016, 2017, 2018, 2019 y (sales): 24, 38, 58, 74, 90 Find the least square regression line y = a x + b. Use the least squares regression line as a model to estimate the sales of the company in 2022.	8
7	a	Implement of k nearest neighbors considering height and weight with corresponding T shirt size as given below. Consider k = 5, what would be the T shirt size for person with weight 61 kg and height of 161cm.	8

		Height (in cms) Weight (in kg 158 58 158 59 158 63 160 59 160 60 163 60 163 61 160 64 163 64 165 61 165 62 165 65	
	b	Implement decision tree to verify the truth tables of AND, OR and XOR gates.	8
		OR	
8	a	Plot the scatter plot of x2, x1 and compute the Principal components for following two dimensional data set X=(x1,x2)={(1,2),(3,3),(3,5),(5,4),(5,6),(6,5),(8,7),(9,8)}	8
	b	Apply k means clustering for the following data set consisting of the scores of two variables on each of seven individuals: Subject A 1 1.0 2 1.5 3 3.0 4 5.0 5 3.5	8
9	a	Why are Generative Adversarial Networks (GANs) so popular? How GAN is used to create images solely from text?	8
	b	Consider a single LSTM cell whose inputs are the current input x(t) and h(t-1), c(t-1) from the previous step; and the output are h(t) and c(t). Assume that the input dimention is D and the dimension of h(t) is H . i. Sketch a LSTM cell showing the various gates inside the cell ,including forget gate f(t) , input gate i(t) and output gate . Reflect all the intermediate gates in the sketch. ii. Write down the equations of the various gates above for each of the weight parameters involved in the definitions, indicate their dimensions.	8
		OR	
10	a	Sketch the network architecture of AlexNet, label all the parameters and dimension of each layers. In one sentence state the main motivation of Resnet block.	8
	b	Discuss the working of the Back Propagation Through Time (BPTT) algorithm.	8

P.Code

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Course Code: EC364TA **Course Title: Digital Signal Processing & Machine learning**

PART-A

Q.No	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10
B T	2	2	2	2	3	1	2	1	1	1
COs	1	1	1	1	2	2	2	2	3	2
Q No	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20
B T	1	2	2	1	2	1	2			
COs	3	3	4	3	4	4	4			

PART-B

Question No		B T Levels	COs addressed		Question No		BT Levels	COs addressed
2	a	3	2		3	a	2	3
	b	2	3			b	2	2
	c					c		
4	a	2	3		5	a	3	1
	b	3	3			b	3	1
	c					c		
6	a	3	1		7	a	3	1
	b	3	2			b	3	2
	c	2	3			c		
8	a	3	4		9	a	4	3
	b	3	4			b	4	3
	c					c		
	d					d		
10	a	4	3		11	a		
	b	4	3			b		
	c					c		

Signature of Scrutinizer: Signature of Chairman:

Name: Name: