SEMESTER –VII

AIT 401	FOUNDATIONS OF DEEP LEARNING	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: Study of this course provides the learners an overview of the concepts and algorithms involved in deep learning. The course covers the basic concepts in neural networks, deep learning, optimization techniques, regularization techniques, convolutional neural networks, recurrent neural networks, autoencoders, generative models. The students will be able to implement deep learning algorithms to solve real-world problems.

Prerequisite: Machine learning concepts

Course Outcomes: After the completion of the course the student will be able to

CO 1	Illustrate the basic concepts of neural networks, deep learning and its practical issues **(Cognitive Knowledge Level : Apply)**
CO 2	Outline the standard regularization and optimization techniques for the effective training of deep neural networks. **(Cognitive Knowledge Level: Understand)**
CO 3	Build convolutional Neural Network (CNN) models for different use cases. **(Cognitive Knowledge Level: Apply)**
CO 4	Apply the concepts of Recurrent Neural Network (RNN), Long Short Term Memory(LSTM), Gated Recurrent Unit (GRU)**. (Cognitive Knowledge Level: Apply)**
CO 5	Explain the concepts of auto encoder, generative models **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12
CO1	✓	✓	✓	✓								✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test1 (percentage)	**Test2 (percentage)**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance: 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module 1: Introduction to Neural Networks and Deep learning

Introduction, The Basic Architecture of Neural Networks - Single Computational Layer: The Perceptron, Multilayer Neural Networks. Activation functions – Sign, Sigmoid, Tanh, ReLU, leaky ReLU, Hard Tanh, Softmax. Loss function. Training a Neural Network with Backpropagation. Practical issues in neural network training. Overfitting, Underfitting, Hyper parameters and Validation sets, Estimators -Bias and Variance.Introduction to deep learning, Deep feed forward network.

Module 2: Training deep models

Introduction, setup and initialization- Kaiming, Xavier weight intializations, Vanishing and exploding gradient problems, Optimization techniques - Gradient Descent (GD), Stochastic GD, GD with momentum, GD with Nesterov momentum, AdaGrad, RMSProp, Adam., Regularization Techniques - L1 and L2 regularization, Early stopping, Dataset augmentation, Parameter tying and sharing, Ensemble methods, Dropout, Batch normalization.

Module 3: Convolutional Neural Networks

Convolutional Neural Networks –Architecture, Convolution operation, Motivation, pooling .Variants of convolution functions, Structured outputs, Data types, Efficient convolution algorithms, Applications of Convolutional Networks, Pre-trained convolutional Architectures : AlexNet, ZFNet, VGGnet-19, ResNet-50.

Module 4: Recurrent Neural Networks

Recurrent neural networks – Computational graphs. RNN design. Encoder – decoder sequence to sequence architectures. Language modeling example of RNN. Deep recurrent networks. Recursive neural networks. Challenges of training Recurrent Networks. Gated RNNs LSTM and GRU.

Case study: BERT, Social Media Sentiment Analysis.

Module 5: Auto-encoders and Generative models.

Autoencoders, *Variational Auto-Encoder*-under complete Auto-encoder, stochastic encoder, denoising encoder, Applications of Autoencoders. Generative models - Boltzmann machines, Deep Belief Networks, Generative Adversarial Networks.

Reference Books

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018
3. Deep Learning, Core Conceps, Methods and Applications- M Gopal, Pearson Education
4. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms (1st. ed.). Nikhil Buduma and Nicholas Locascio. 2017. O'Reilly Media, Inc.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Suppose you have a 3-dimensional input x = (x1, x2, x3) = (2, 2, 1) fully connected with weights (0.5, 0.3, 0.2) to one neuron which is in the hidden layer with sigmoid activation function. Calculate the output of the hidden layer neuron.
2. Consider the case of the XOR function in which the two points {(0, 0),(1, 1)} belong to one class, and the other two points {(1, 0),(0, 1)} belong to the other class. Design a multilayer perceptron for this binary classification problem.
3. Sketch the typical learning curves for the training and validation sets, for a setting where

overfitting occurs at some point. Assume that the training set and the validation set are of the same size.

Course Outcome 2 (CO2):

1. Explain how L2 regularization improves the performance of deep feed forward neural networks.
2. Explain how L1 regularization method leads to weight sparsity.
3. Derive update rules for parameters in the multi-layer neural network through the gradient descent.

Course Outcome 3(CO3):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. Weight sharing allows CNNs to deal with image data without using too many parameters. Does weight sharing increase the bias or the variance of a model?

Course Outcome 4 (CO4):

1. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.
2. List the differences between LSTM and GRU
3. Show the steps involved in an LSTM to predict stock prices.Give one advantage of using an RNN rather than a convolutional network.

Course Outcome 5 (CO5):

1. Is an autoencoder for supervised learning or for unsupervised learning? Explain briefly.
2. List the difference between Boltzmann Machine and Deep Belief Network.

Model Question paper

QP CODE: PAGES:3

Reg No:_____

Name :_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code*: AIT 401**

Course Name: Foundations of Deep Learning

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Illustrate the limitation of a single layer perceptron with an example
2. Specify the advantages of ReLU over sigmoid activation function.
3. Derive weight updating rule in gradient descent when the error function is a) mean squared error b) cross entropy
4. List any three methods to prevent overfitting in neural networks
5. Illustrate the strengths and weaknesses of convolutional neural networks.
6. What happens if the stride of the convolutional layer increases? What can be the maximum stride? Justify your answer
7. List the differences between LSTM and GRU
8. How does a recursive neural network work?
9. List the difference between Boltzmann Machine and Deep Belief Network.
10. How does the variational auto-encoder(VAE) architecture allow it to generate new data points, compared to auto-encoder, which cannot generate new data points?

(10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11.

a. Explain back propagation algorithm for neural network training. (9 marks)
b. "How does bias and variance trade-off affect machine learning algorithms? (5 marks)

OR

12.
a. With an example classification problem, explain the following terms:
a) Hyper parameters b) Training set c) Validation sets d) Bias e) Variance (8 marks)
b. Compare overfitting and underfitting. How it can affect model generalization ? (6 marks)

13.
a. Differentiate gradient descent with and without momentum. Give equations for weight updation in GD with and without momentum. Illustrate plateaus, saddle points and slowly varying gradients. (8 marks)
b. Describe the effect in bias and variance when a neural network is modified with more number of hidden units followed with dropout regularization. (6 marks)

OR

14.
a. Explain how L2 regularization improves the performance of deep feed forward neural networks. (7 marks)
b. Initializing the weights of a neural network with very small or large random numbers is not advisable. Justify. (7 marks)

15.
a. Consider an activation volume of size 13×13×64 and a filter of size 3×3×64. Discuss whether it is possible to perform convolutions with strides 2, 3 and 5. Justify your answer in each case. (6 marks)
b. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
(8 marks)

OR

16.
a. Explain the following convolution functions a)tensors b) kernel flipping c) down sampling d) strides e) zero padding. (10 marks)
b. What is the motivation behind convolution neural networks? (4 marks)

17. a. If we have a recurrent neural network (RNN), we can view it as a different type of network by "unrolling it through time". Briefly explain what that means. (6 marks)

b. Explain the architecture of GRU. (8 marks)

OR

18.

a. The vanishing gradient problem is more pronounced in RNN than in traditional neural networks. Give reason. Discuss a solution for the problem. (7 marks)

b. Show the steps involved in an LSTM to predict stock prices.Give one advantage of using an RNN rather than a convolutional network. (7 marks)

19.

a. Generative Adversarial Networks(GANs) include a generator and a discriminator. Sketch a basic GAN using those elements, a source of real images, and a source of randomness. (10 marks)

b. The word "adversarial" in the acronym for GANs suggests a two-player game. What are the two players, and what are their respective goals? (4 marks)

OR

20.

a. Explain auto encoder with an example. (7 marks)

b. Explain Generative Adversarial Networks using suitable diagram. (7 marks)

(14X5=70)

Teaching Plan		
No	Topic	No. of Lectures (**36 Hours**)
1	**Module 1: Introduction to neural network and Deep Learning**	**7**
1.1	Introduction, The Basic Architecture of Neural Networks - Single Computational Layer: The Perceptron.	1 hour
1.2	Multilayer Neural Networks.	1 hour
1.3	Activation functions - Sigmoid, Tanh, ReLU, leaky ReLU, Hard Tanh, Softmax. Loss function.	1 hour
1.4	Training a Neural Network with Backpropagation.	1 hour
1.5	Practical issues in neural network training	1 hour
1.6	Overfitting, Underfitting, Hyper parameters, Validation sets	1 hour
1.7	Estimators -Bias and Variance, Introduction to deep learning, Deep feed forward network	1 hour
2	**Module 2: Training deep models**	**8**
2.1	Introduction, setup and initialization issues- Kaiming and Xavier weight initializations	1 hour
2.2	Vanishing and exploding gradient problems	1 hour
2.3	Concepts of optimization, Gradient Descent (GD)	1 hour
2.4	Stochastic GD, GD with momentum, GD with Nesterov momentum	1 hour
2.5	AdaGrad, RMSProp, Adam	1 hour
2.6	Concepts of Regularization, L1 and L2 regularization	1 hour
2.7	Early stopping, Dataset augmentation	1 hour

2.8	Parameter tying and sharing, Ensemble methods, Dropout, Batch Normalization	1 hour
3	**Module 3: Convolutional Neural Network**	**8**
3.1	Convolutional Neural Networks, Architecture	1 hour
3.2	Convolution operation	1 hour
3.3	Motivation, pooling	1 hour
3.4	Variants of convolution functions	1 hour
3.5	Structured outputs, Data types	1 hour
3.6	Efficient convolution algorithms	1 hour
3.7	Applications of Convolutional Networks	1 hour
3.8	Case Studies of Convolutional Architectures : AlexNet, ZFNet, VGGNet-19, ResNet-50	1 hour
4	**Module 4 : Recurrent Neural Network**	**7**
4.1	Recurrent neural networks – Computational graphs	1 hour
4.2	RNN design, Encoder – decoder sequence to sequence architectures	1 hour
4.3	Language modeling example of RNN	1 hour
4.4	Deep recurrent networks, Recursive neural networks, Challenges of training Recurrent Networks	1 hour
4.5	LSTM	1 hour
4.6	GRU	1 hour
4.7	Case Study- BERT, Sentiment Analysis	1 hour
5	**Module 5 : Autoencoders and Generative models**	**6**
5.1	Autoencoders	1 hour
5.2	VariationalAutoEncoder , Applications of Autoencoders	2 hour
5.3	Boltzmann machines,	1 hour
5.4	Deep Belief Networks,	1 hour

5.5	Generative Adversarial Networks.	1 hour

PROGRAM ELECTIVE II

AIT 413	ADVANCED CONCEPTS OF MICROPROCESSOR AND MICRO CONTROLLER	Category	L	T	P	Credit
		PEC	2	1	0	3

Preamble: The course enables the learners capable of understanding the fundamental architecture of microprocessors and micro controllers. This course focuses on the architecture, assembly language programming, interrupts, interfacing of microprocessors with peripheral devices and microcontrollers and its programming. It helps the learners to extend the study of latest advanced microprocessors and develop hardware-based solutions.

Prerequisite: Sound knowledge in Logic System Design and Computer organization & architecture.

CO#	Course Outcomes
CO1	Illustrate the **architecture**, modes of operation and addressing modes of microprocessors **(Cognitive knowledge: Understand)**
CO2	Develop 8086 **assembly** language programs. Demonstrate interrupts, its **handling** in 8086 **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate how different peripherals are interfaced with 8086 microprocessors (8259,8255,8254,8257) (**Cognitive Knowledge Level: Understand**)
CO4	Illustrate the architecture and features of advanced microprocessors (**Cognitive knowledge: Understand)**
CO5	Outline features of **microcontrollers** and develop low level programs. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test1 (%)	Test2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Tests : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations must be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1(Evolution of microprocessors):

8086 microprocessor – Architecture and signals,Stack structure of 8086, Physical Memory organization, Minimum and maximum mode of 8086 system and timings. Comparison of 8086 and 8088.

Module-2 (Addressing modes and instructions):

Addressing Modes of 8086. Instruction set – data copy /transfer instructions, arithmetic instructions, logical instructions, string manipulation instructions, branch instructions, unconditional and conditional branch instruction, flag manipulation and processor control instructions. Assembler Directives and operators. Basic Assembly Language Programming with 8086.Interrupts - Types of Interrupts and Interrupt Service Routine- Handling Interrupts in 8086

Module- 3 (Interfacing chips):

Programmable Interrupt Controller - 8259, Architecture (Just mention the control word, no need to memorize the control word). Programmable Peripheral Input/output port 8255 - Architecture and modes of operation- Programmable interval timer 8254- Architecture and modes of operation- DMA controller 8257 Architecture (Just mention the control word, no need to memorize the control word of 8254 and 8257).

Module- 4 (Advanced Microprocessors):

Introduction to 32-bit advanced microprocessors- Salient Features and comparison of 80286, 80386 and 80486. Introduction to Pentium Microprocessors-Salient features of 80586-System Architecture-Brach predication-Enhanced Instruction set of Pentium-Journey to Pentium -Pro and Pentium-II.

Module- 5 (Microcontrollers):

8051 Architecture- Register Organization- Memory and I/O addressing- Interrupts and Stack- 8051 Addressing Modes- Instruction Set- data transfer instructions, arithmetic instructions, logical instructions, Boolean instructions, control transfer instructions- Simple programs.

Text Books

1. Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw Hill.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education.
3. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing Pvt. Ltd.

Reference Books

1. Barry B. Brey, The Intel Microprocessors – Architecture, Programming and Interfacing, Eighth Edition, Pearson Education.
2. A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw Hill
3. Douglas V. Hall, SSSP Rao, Microprocessors and Interfacing, Third Edition, McGrawHill Education.

Sample Course Level Assessment Questions

Course Outcome1 (CO1):

1) Describe how pipelining is implemented in 8086 microprocessors
2) Illustrate maximum mode signals in 8086.

Course Outcome 2(CO2):

1) Write an 8086-assembly language program for sorting a sequence of N, 8-bit numbers. Describe the modifications that can be done on the above program so that it will sort N, 16-bit numbers. Rewrite the program with those modifications also.

Course Outcome 3 (CO3):

1) Give the sequence of instructions for setting the IVT for interrupt type 23H. Assume the Interrupt Service Routine, is present in the code segment named CODE.
2) Describe the role of Interrupt Request register and In service register in 8259.
3) Specify the importance of the DMA address register and Terminal count register in 8257

Course Outcome 4(CO4):

1) What are the four major architectural advancement in 80486 over 80386? What are the data types supported by 80486?
2) Classify the instruction set of Pentium processor?
3) Explain branch prediction mechanism for Pentium processor.

Course Outcome 5(CO5):

1) Write an 8051-assembly language program to count the number of 1's and 0's in each8-bit number
2) Write an 8051-assembly language program for computing the square root of an 8-bit number.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES: 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT413

Course Name: ADVANCED CONCEPTS OF MICROPROCESSOR AND MICRO CONTROLLER

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Describe the functions of following signals in 8086
   a) NMI b) ALE

2. The value of Code Segment (CS) Register is 4042H and the value of different offsets is as follows:
   BX:2025H,
   IP:0580H,
   DI:4247H
   Calculate the effective address of the memory location pointed by the CS register.

3. Explain the following instructions with example.
   AAD b. AAS c. AAA

4. Specify the use of following assembler directives - EQU, EVEN

5. Differentiate between maskable and non-maskable interrupts?

6. What are the three different I/O modes supported by 8255?

7. Explain the branch prediction in Pentium processors.

8. Compare the features of 80286,80386 and 80486?

9. Differentiate between indirect and indexed addressing modes in 8051.

10. Write the sequence of 8051 instructions to store any two numbers at two consecutive locations 70H and 71H, multiply them and store the result in location 72H. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Specify the significance of segmentation and how it is implemented in 8086 **(5)**

(b) Explain the maximum mode signals in 8086. **(9)**

OR

12. (a) Explain the physical address calculation in 8086 with example. **(4)**

(b) Explain the physical memory organization of 8086 with a neat diagram. How does the 8086 processor access a word from an odd memory location? How many memory cycles does it take? **(10)**

13. (a) Write an 8086-assembly language program for finding the sum of the squares of first N natural numbers. Calculate the squares of each number using a subroutine SQUARE. **(10)**

(b) Describe any four control transfer instructions in 8086. **(4)**

OR

14. (a) Write an 8086-assembly language program for printing the reverse of a given input string. **(5)**

(b) Explain the addressing modes for sequential control flow instructions in 8086. **(9)**

15. (a) Discuss the following control words of 8259 **(5)**
    a) Initialization command word
    b) Operating Command word

(b) Explain the architecture of 8259 with diagram **(9)**

OR

16. (a) Describe the internal architecture of 8255 with block diagram. **(10)**

(b) Identify the mode and I/O configuration for ports A, B and C of an 8255 after its control register is loaded with 86 H? **(4)**

17. (a) Explain the architecture of Pentium processors with a neat diagram **(10)**

(b) Explain the features of Pentium-Pro and Pentium -II. **(4)**

OR

18. (a) Explain the enhanced instruction sets of Pentium processors in detail **(8)**

(b) Explain the super scalar execution of Pentium processors. **(6)**

19. (a) Explain the architecture of 8051 microcontroller. **(9)**

(b) Write an 8051-assembly language program for adding two matrices whose elements are stored sequentially in some memory location. Assume suitable locations. **(5)**

OR

20. (a) Explain the internal data memory organization of 8051. **(9)**

(b) Describe the control transfer instructions of 8051microcontroller. **(5)**

Teaching Plan

No	Contents	No of Lecture Hrs
Module 1: (Evolution of microprocessors) (7hours)		
1.1	Architecture of 8086	1hour
1.2	Signals in 8086	1hour
1.3	Memory Segmentation	1hour
1.4	Physical Memory organization	1hour
1.5	Minimum and maximum mode 8086 system and timings (Lecture 1)	1hour
1.6	Minimum and maximum mode 8086 system and timings (Lecture 2)	1hour

1.7	Comparison of 8086 and 8088	1hour
Module 2 :(programming of 8086) (8 hours)		
2.1	Addressing Modes of 8086	1 hour
2.2	Instruction set – data copy/transfer instructions	1hour
2.3	arithmetic instructions, logical instructions	1hour
2.4	unconditional and conditional branch instruction	1hour
2.5	flag manipulation and processor control instructions	1hour
2.6	Assembler Directives and operators	1hour
2.7	Assembly Language Programming with 8086(Lecture 1)	1hour
2.8	Types of interrupts, ISR and handling interrupts in 8086	1hour
Module 3: (Interfacing chips) (7 hours)		
3.1	Programmable Interrupt Controller -8259 (Lecture 1)	1hour
3.2	Programmable Peripheral Input/output port- 8255 (Lecture 1)	1hour
3.3	Programmable Peripheral Input/output port- 8255 (Lecture 2)	1hour
3.4	Programmable interval timer 8254 (Lecture 1)	1hour
3.5	Programmable interval timer 8254 (Lecture 2)	1hour
3.6	DMA controller 8257 Architecture (Lecture 1)	1hour
3.7	DMA controller 8257 Architecture (Lecture 2)	1hour
Module 4 :(Advanced Microprocessors) (7 hours)		
4.1	Introduction to 32-bit microprocessors	1hour
4.2	Salient features of 808286, 80386 and 80486 and comparison (Lecturer 1)	1hour
4.3	Salient features of 808286,80386 and 80486 and comparison (Lecturer 2)	1hour
4.4	80586 -Pentium System Architecture	1hour
4.5	Branch prediction and Enhanced instruction sets	1hour
4.6	MMX architecture, Data types and instruction sets.	1hour
4.7	Journey to Pentium -pro and Pentium -II	1hour
Module 5: (Microcontrollers) (7 hours)		
5.1	8051 Architecture (Lecture 1)	1hour
5.2	8051 Architecture (Lecture 2)	1hour
5.3	Register Organization, Memory and I/O addressing	1hour

5.4	Interrupts and Stack,Addressing Modes	1hour
5.5	Data transfer instructions, Arithmetic instructions, Logical instructions,	1hour
5.6	Boolean instructions, Control transfer instructions	1hour
5.7	Programming of 8051 (Lecture 1)	1hour

CST423	CLOUD COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand cloud computing concepts. This course includes basic understanding of virtualization, fundamentals of cloud security, cloud computing based programming techniques and different industry popular cloud computing platforms. This course enables the student to suggest cloud based solutions to real world problems.

Prerequisite: Basic understanding of computer networks and operating systems.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the various cloud computing models and services. **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the significance of implementing virtualization techniques. **(Cognitive Knowledge Level: Understand**)
CO3	Explain different cloud enabling technologies and compare private cloud platforms **(Cognitive Knowledge Level: Understand**)
CO4	Apply appropriate cloud programming methods to solve big data problems. (Cognitive Knowledge Level: **Apply**)
CO5	Describe the need for security mechanisms in cloud (**Cognitive Knowledge Level: Understand**)
CO6	Compare the different popular cloud computing platforms **(Cognitive Knowledge Level: Understand**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓	✓									✓
CO3	✓											✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓										✓
CO6	✓				✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing the remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module 1: Fundamental Cloud Computing (7 Hours)

Traditional computing- Limitations. Overview of Computing Paradigms-Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. NIST reference Model-Basic terminology and concepts. Cloud characteristics, benefits and challenges,Roles and Boundaries. Cloud delivery (service) models-Infrastructure-as-a-Service (IaaS), Platform-as-a-Service(PaaS),Software-as-a-Service (SaaS), XaaS (Anything-as-a-service)-Cloud deployment models- Public cloud, Community cloud, Private cloud, Hybrid cloud.

Module 2: Virtualization (7 Hours)

Introduction to virtualization-Virtualizing physical computing resources, Virtual Machines (Machine virtualization), non-virtualized v/s virtualized machine environments. Types of VMs-process VM v/s system VM, Emulation, interpretation and binary translation. Hardware-level virtualization- Hypervisors/VMM. Types of Hypervisors. Full Virtualization, Para- Virtualization, Hardware-assisted virtualization, OS level virtualization. Basics of Network Virtualization, Storage Virtualization and Desktop Virtualization, Pros and cons of virtualization. Case Study-Xen: Para-virtualization, VMware: full virtualization.

Module 3: Cloud-Enabling Technologies, Private cloud platforms and programming (7 Hours)

Broadband networks and internet architecture- Internet Service Providers (ISPs), Data center technology, Web technology, Multitenant technology, Service technology. Resource provisioning techniques-static and dynamic provisioning.

Open-source software platforms for private cloud-OpenStack, CloudStack, Basics of Eucalyptus, Open Nebula, Nimbus.

Cloud Programming- Parallel Computing and Programming Paradigms. Map Reduce – Hadoop Library from Apache, HDFS, Pig Latin High Level Languages, Apache Spark.

Module 4: Fundamental Cloud Security (7 Hours)

Basic terms and concepts in security- Threat agents, Cloud security threats/risks, Trust. Operating system security-Virtual machine security- Security of virtualization- Security Risks Posed by Shared Images, Security Risks Posed by Management OS. Infrastructure security- Network Level Security, Host Level Security, Application level security, Security of the PhysicalSystems. Identity & Access Management- Access Control.

Module 5: Popular Cloud Platforms (9 Hours)

Amazon Web Services(AWS):- AWS ecosystem- Computing services, Amazon machine images, Elastic Compute Cloud (EC2), Advanced compute services. Storage services-Simple Storage System (Amazon S3), Elastic Block Store (Amazon EBS), Database Services, Amazon CDN Services and Communication services.

Google Cloud Platform:- IaaS Offerings: Compute Engine (GCE), Cloud Storage, PaaS Offerings: Google App Engine (GAE), Storage services, Application services, Compute services, Database Services, SaaS Offerings: Gmail, Docs, Google Drive.

Microsoft Azure: Azure Platform Architecture, Hyper-V, Azure Virtual Machine, Compute services, Storage services.

Text Books

1. Thomas, E., Zaigham M., Ricardo P "Cloud Computing Concepts, Technology & Architecture.", (2013 Edition). Prentice Hall.
2. Buyya, R., Vecchiola, C., & Selvi, S. T. "Mastering cloud computing: foundations and applications programming", (2017 Edition), Morgan Kaufmann.
3. Bhowmik, S., "Cloud computing", (2017 Edition). Cambridge University Press.

References

1. Marinescu, D. C., "Cloud computing: theory and practice.", (2017 Edition). Morgan Kaufmann.
2. Buyya, R., Broberg, J., & Goscinski, A. M., "Cloud computing: Principles and paradigms" (2011 Edition). John Wiley & Sons.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. "*A hybrid cloud is a combination of two or more other cloud deployment models*". Justify the statement with an example.
2. What are the main characteristics of a Platform-as-a-Service solution?
3. How does cloud computing help to reduce the time to market for applications and to cut down capital expenses?
4. Differentiate public and private clouds in terms of flexibility.

Course Outcome 2 (CO2):

1. Define virtualization. What is the role of VMM in virtualization?
2. Explain various implementation levels of Virtualization.
3. State the differences between a traditional computer and a virtual machine.

Course Outcome 3 (CO3):

1. Differentiate between on-premise and cloud-based internetworking.
2. What are the benefits of Data Center Technologies?
3. What are the characteristics of Multi-tenant technology?
4. How can virtualization be implemented at the hardware level?

Course Outcome 4 (CO4):

1. Write a Hadoop MapReduce program that counts the number of occurrences of each character in a file.
2. Write a Hadoop MapReduce program to find the maximum temperature in the weather dataset.

Course Outcome 5 (CO5):

1. Why is it harder to establish security in the cloud?
2. Explain in detail about the security issues one should discuss with a cloud-computing vendor.
3. List and Explain major cloud security challenges.

Course Outcome 6 (CO6):

1. Explain the cloud based databases.
2. With a neat diagram, write about Google App Engine for PaaS applications.
3. Differentiate between amazon SimpleDB and Amazon RDS.
4. *"Storage services in the cloud are offered in two different forms as IaaS and as SaaS".* Explain.

Model Question Paper

QP Code: **Total Pages : 3**

Reg No:_____ **Name :**_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST423
Course Name: Cloud Computing

Duration: 3 Hrs **Max. Marks :100**

PART A
Answer all Questions. Each question carries 3 Marks (10 x 3 = 30 Marks)

1. Is the IT outsourcing model of traditional computing similar to cloud computing? Justify.

2. Why is grid computing considered as the predecessor of cloud computing? Explain.

3. What is virtualization and what are its benefits?

4. Explain why a hypervisor is also called a virtual machine monitor?

5. Differentiate between multi-tenancy and virtualization.

6. "*The field of service technology is a keystone foundation of cloud computing*". Explain.

7. Discuss any two identity management techniques used in cloud computing.

8. Differentiate between mandatory access control (MAC) and discretionary Access Control (DAC).

9. Differentiate between Amazon S3 and Amazon EBS.

10. Explain the database service offered by google cloud.

(10 x3 =30)

PART B

Answer any one Question from each Module. Each question carries 14 Marks

11. **(a)** Discuss the cloud computing reference model. **(8)**

(b) Which are the basic components of an IaaS-based solution for cloud computing? Also provide some examples of IaaS implementations. **(6)**

OR

12. **(a)** List down the characteristics and challenges of cloud computing. **(6)**

(b) Classify the various types of clouds. **(8)**

13. **(a)** List and discuss various types of virtualization. **(8)**

(b) Differentiate between full virtualization and paravirtualization. **(6)**

OR

14. **(a)** What isXen? Discuss its elements for virtualization. **(8)**

(b) Explain the design requirements for Virtual Machine Monitor (VMM). **(6)**

15. **(a)** Explainthe broadband networks and internet architecture. **(8)**

(b) List and explain the technologies and components of data centers. **(6)**

OR

16. **(a)** What are the major functions of the MapReduce framework? Explain the logical data flow of MapReduce function using a suitable example . **(8)**

(b) Write a Hadoop MapReduce program that counts the number of occurrences of each word in a file. **(6)**

17. **(a)** Explain common threats and vulnerabilities in cloud-based environments with suitable examples. **(8)**

(b) Discuss the security risks posed by shared images with suitable examples. **(6)**

OR

18.	**(a)**	Explain the operating system security in cloud computing.	**(8)**
	(b)	What do you mean by threat agents?. Explain different types of threat agents.	**(6)**
19.	**(a)**	Describe Amazon EC2 and its basic features.	**(8)**
	(b)	Illustrate the architecture of Amazon S3.	**(6)**

OR

20.	**(a)**	Describe the core components of Google AppEngine.	**(8)**
	(b)	Explain the architecture of Windows Azure.	**(6)**

Teaching Plan

No	Contents	No. of Lecture Hours (37 hrs)
	Module 1 (Fundamental Cloud Computing) (6 hours)	
1.1	Traditional computing: Limitations.	1
1.2	Overview of Computing Paradigms: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing.	1
1.3	NIST reference Model, Basic terminology and concepts.	1
1.4	Cloud characteristics and benefits, challenges. Roles and Boundaries.	1
1.5	Cloud delivery (service) models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), XaaS (Anything-as-a-service).	1
1.6	Cloud deployment models: Public cloud, Community cloud, Private cloud, Hybrid cloud.	1

Module 2(Virtualization)(7 Hours)		
2.1	Introduction to virtualization, Virtualizing physical computing resources Virtual Machines (Machine virtualization):- non-virtualized v/s virtualized machine environments.	1
2.2	Types of VMs: process VM v/s system VM, Emulation, interpretation and binary translation.	1
2.3	Hardware-level virtualization: Hypervisors/VMM, Types of Hypervisors.	1
2.4	Full Virtualization, Para-Virtualization, Hardware-assisted virtualization, OS level virtualization.	1
2.5	Basics of Network Virtualization, Storage Virtualization and Desktop Virtualization, Pros and cons of virtualization.	1
2.6	Case Study: Xen: Para-virtualization.	1
2.7	Case Study: VMware: full virtualization.	1
Module 3 (Cloud-Enabling Technologies, Private cloud platforms and programming) (9 Hours)		
3.1	Broadband networks and internet architecture: Internet Service Providers (ISPs), Data center technology, Web technology, Multitenant technology, Service technology.	1
3.2	Resource provisioning techniques: static and dynamic provisioning.	1
3.3	Open-source software platforms for private cloud: OpenStack, CloudStack.	1
3.4	Basics of Eucalyptus, Open-Nebula, Nimbus.	1
3.5	Cloud Programming: Parallel Computing and Programming Paradigms.	1
3.6	Map Reduce.	1
3.7	Hadoop Library from Apache, HDFS.	1
3.8	Pig Latin High Level Languages	1
3.9	Apache Spark.	1

Module 4 (Fundamental Cloud Security) (7 Hours)		
4.1	Basic terms and concepts in security, Threat agents.	1
4.2	Cloud security threats/risks, Trust.	1
4.3	Operating system security, Virtual machine security.	1
4.4	Security of virtualization.	1
4.5	Security Risks posed by Shared Images, Security Risks posed by Management OS.	1
4.6	Infrastructure security: - Network Level Security, Host Level Security, Application level security, Security of the Physical Systems.	1
4.7	Identity & Access Management, Access Control.	1
Module 5 (Popular Cloud Platforms) (8 Hours)		
5.1	Amazon Web Services(AWS):- AWS ecosystem, Computing services: Amazon machine images, Elastic Compute Cloud (EC2).	1
5.2	Advanced computing services, Storage services: Simple Storage System (Amazon S3), Elastic Block Store (Amazon EBS).	1
5.3	Database Services, Amazon CDN Services and Communication services.	1
5.4	Google Cloud Platform:- IaaS Offerings: Compute Engine (GCE), Cloud Storage.	1
5.5	PaaS Offerings: Google App Engine (GAE), Storage services, Application services, Compute services.	1
5.6	Database Services, SaaS Offerings: Gmail, Docs, Google Drive.	1
5.7	Microsoft Azure: Azure Platform Architecture, Hyper-V, Azure Virtual Machine.	1
5.8	Azure Compute services, Storage services.	1

CST433	SECURITY IN COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to explore various algorithms to offer confidentiality, integrity, authentication &non-repudiation services and different attacks on system security with their countermeasures. It covers classical encryption techniques, symmetric and public key crypto-system, key distribution techniques, authentication functions, intruders, malicious software, and DDoS attacks. The concepts covered in this course enable the learners in effective use of cryptographic algorithms and appropriate countermeasures for securing real life applications.

Prerequisite: A fundamental knowledge in mathematical foundations of security.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Identify the security services provided against different types of security attacks. **(Cognitive Knowledge Level: Understand)**
CO2	Illustrate classical encryption techniques for information hiding. **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate symmetric/asymmetric key cryptosystems for secure communication. **(Cognitive Knowledge Level: Apply)**
CO4	Explain message integrity and authentication methods in a secure communication scenario. **(Cognitive Knowledge Level: Understand)**
CO5	Interpret public/secret key distribution techniques for secure communication. **(Cognitive Knowledge Level: Understand)**
CO6	Identify the effects of intruders, malicious software and distributed denial of service attacks on system security. **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓			✓						✓
CO5	✓	✓	✓									✓
CO6	✓	✓	✓			✓		✓				✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (%)	Test 2 (%)	End Semester Examination (%)
Remember	30	30	30
Understand	40	40	40

Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. Therewill be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer allquestions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Outof the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1 (Basics of Security and Traditional Cryptosystems)
OSI security architecture – Security attacks, Services, Mechanisms. Cryptography vs Cryptanalysis. Classical encryption techniques – Symmetric cipher model. Substitution ciphers – Monoalphabetic vs Polyalphabetic ciphers, Caesar cipher, Affine cipher, Playfair cipher, Vigenere cipher, Hill cipher. Transposition ciphers – Keyless, Keyed, Double transposition.

Module-2 (Modern Symmetric Key Cryptosystems)
Symmetric key ciphers – Block vs Stream ciphers, Block cipher components, Product ciphers, Feistel and Non-Feistel ciphers. Data Encryption Standard (DES) – Structure, Key generation, Design criteria, Weaknesses, Double DES, Triple DES. Advanced Encryption Standard (AES) – Structure, Key expansion. Block cipher modes of operation – Electronic Codebook Mode (ECB), Cipher Block Chaining Mode (CBC), Cipher Feedback Mode (CFB), Output Feedback Mode (OFB), Counter Mode (CTR). Stream ciphers – Structure, RC4.

Module-3 (Public Key Cryptosystems)
Introduction to public key cryptosystems – Principles, Applications, Requirements, Conventional vs Public key cryptosystems. RSA cryptosystem – Algorithm, Security, Attacks. ElGamal cryptosystem – Algorithm. Diffie-Hellman key exchange – Algorithm, Man-in-the-middle attack. Elliptic Curve Cryptography (ECC) – ElGamal ECC, Key exchange using ECC.

Module-4 (Message Integrity and Authentication)
Hash functions – Security requirements, Secure Hash Algorithm (SHA-512). Message Authentication Code (MAC) – Requirements, Uses, Hash-based MAC (HMAC), Cipher-based MAC (CMAC). Digital signatures – Attacks, Forgeries, Requirements, Direct vs Arbitrated digital signatures, RSA digital signature, ElGamal digital signature, Digital Signature Standard (DSS).

Module-5 (Key Distribution and System Security)
Key management – Distribution of secret keys using symmetric and asymmetric encryption, Distribution of public keys. System security – Intruders, Intrusion detection techniques, Password management. Malicious software – Viruses, Related threats, Countermeasures. Distributed Denial of Service (DDoS) attacks – Types, Countermeasures.

Text Books
1. William Stallings, Cryptography and Network Security Principles and Practice, 4/e, Pearson Ed.
2. Behrouz A Forouzan, Cryptography and Network Security, 3/e, Tata McGraw-Hill.

References

1. Charles P Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, Security in Computing, 5/e, Prentice Hall.
2. G.A. Jones & J.M. Jones, Elementary Number Theory, Springer UTM, 2007.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define the type of security attack in the following case: A student breaks into a teacher's office to obtain a copy of the next day's exam question paper.
2. Which security mechanism is provided in the following case: A bank requires the customer's signature for a withdrawal.

Course Outcome 2 (CO2):

1. Alice wishes to send the message "COME BACK EARLY" to Bob, using Playfair cipher. The key to be used is "SAFFRON". Show the process of encryption.
2. Using Affine cipher, encrypt "HOT" and decrypt "JDG". Key is (7, 3).
3. Implement the Vigenere cipher method in a suitable programming language. (Assignment)

Course Outcome 3 (CO3):

1. If the DES key with parity bit is 0123 ABCD 2562 1456, find the first round key.
2. In RSA, given p=19, q=23, public key(e)=3, find n, ϕ(n) and private key(d).
3. Implement any two symmetric/asymmetric encryption techniques in a suitable programming language. (Assignment)

Course Outcome 4 (CO4):

1. Describe the steps involved in generating a Hash-based MAC.
2. Using ElGamal scheme, generate the signatures for the message M=400 with p=881, d=700 and r=17.
3. A company wishes to implement a secure authentication mechanism for communication. As a system security admin suggest any two ways of implementing such a mechanism. (Assignment)

Course Outcome 5 (CO5):

1. List any two ways in which secret keys can be distributed to two communicating parties.
2. Explain the significance of a public-key authority in the distribution of public keys.

Course Outcome 6 (CO6):

1. What are false positives and negatives in the context of Intrusion Detection Systems? How can we reduce these two?
2. Distinguish between a direct DDoS attack and a reflector DDoS attack.
3. Bob works as a network administrator in ABC & Co. On a day of his absence, he shared his admin password with one of his colleagues, John, to manage a network issue. Later John started misusing this privilege by launching DoS attacks in the network. Describe the ethical issues in this scenario and how can this be avoided? (Assignment)

Model Question Paper

QP CODE: **PAGES: ___**

Reg No:_____
Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST433
Course Name: SECURITY IN COMPUTING

Max Marks: 100 **Duration: 3 Hours**

PART A
(Answer All Questions. Each question carries 3 marks)

1. Differentiate between passive attack and active attack.
2. Use an Affine cipher to encrypt the message “SECURITY” with the key pair(7,2) in modulus 26.
3. Compare stream cipher and Block cipher with example.

4. Differentiate between diffusion and confusion.

5. Define the elliptic curve logarithm problem.

6. Consider an ElGamal scheme with a common prime q = 71 and a primitive root α = 7. If B has a public key $Y_B = 3$ and A chose the random number k = 2, what is the ciphertext of the message M = 30?

7. Give the requirements of MAC function.

8. Specify the different types of forgery in digital signature.

9. List three different classes of intruders.

10. Mention the phases of operation of a virus. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Illustrate the two approaches to attack a conventional encryption scheme. **(4)**

(b) A Hill cipher is setup with the key matrix $\begin{bmatrix} 9 & 4 \\ 5 & 7 \end{bmatrix}$. **(10)**

Encrypt the text "COMPUTER". Show the calculations for the corresponding decryption of the ciphertext to recover the original text back.

OR

12. (a) Encrypt the text "this is an exercise and complete it" using transposition cipher with the key (3,2,1,4,5). Show decryption of the ciphertext to recover the original text back. **(6)**

(b) Encrypt the message "the house is being sold tonight"using the following ciphers. Ignore the space between words. **(8)**

i) Vigenere cipher with key = "largest".

ii) Autokey system of Vigenere cipher with key ="largest".

13. (a) How is round key generated in DES? **(4)**

(b) Illustrate AES encryption in detail. **(10)**

OR

14. (a) Explain the construction of S-box in AES. **(5)**

(b) Summarize the primitive operations in RC4 algorithm. **(9)**

15. (a) Compare the Cipher Block Chaining Mode (CBC) and Cipher Feedback Mode (CFB) of block ciphers. **(6)**

(b) Explain RSA cryptosystem. In an RSA cryptosystem a participant A uses two prime numbers p=13 and q=17 to generate public key and private key. The public key of A is 35. Find the private key of A. **(8)**

OR

16. (a) Illustrate ElGamal cryptosystem. **(6)**

(b) Consider a Diffie–Hellman scheme with a common prime q=11 and a primitive root α=2. **(8)**

i) Show that 2 is a primitive root of 11.

ii) If User A has public key Y_A= 9, what is A's private key X_A?

iii) If User A has public key Y_B= 3, what is the shared secret key K, shared with A?

17. (a) Describe different types of arbitrated digital signature techniques. **(6)**

(b) Explain Cipher – Based Message Authentication Code. **(8)**

OR

18. (a) Explain the attacks on digital signature. **(5)**

(b) Describe the working of SHA-512 with diagrams. **(9)**

19. (a) Explain four techniques used to avoid guessable passwords. **(6)**

(b) Describe the different techniques for public key distribution. **(8)**

OR

20. (a) Explain different types of Simple DDoS attack and its countermeasures. **(6)**

(b) Differentiate between statistical anomaly detection and rule-based intrusion detection. **(8)**

Teaching Plan

No	Contents	No.of Lecture Hours (35Hrs)
Module-1 (Basics of Security and Traditional Cryptosystems) (6 hrs)		
1.1	OSI security architecture – Security attacks, Services, Mechanisms	1
1.2	Cryptography vs Cryptanalysis. Classical encryption techniques – Symmetric cipher model	1
1.3	Substitution ciphers – Monoalphabetic vs Polyalphabetic ciphers, Caesar cipher, Affine cipher	1
1.4	Playfair cipher, Vigenere cipher	1
1.5	Hill cipher	1
1.6	Transposition ciphers – Keyless, Keyed, Double transposition	1
Module-2 (Modern Symmetric Key Cryptosystems) (9hrs)		
2.1	Symmetric key ciphers – Block vs Stream ciphers, Block cipher components, Product ciphers, Feistel and Non-Feistel ciphers	1
2.2	Data Encryption Standard (DES) – Structure, Key generation	1
2.3	Design criteria, Weaknesses	1
2.4	Double DES, Triple DES	1
2.5	Advanced Encryption Standard (AES) – Overall Structure	1
2.6	Stages of encryption/decryption	1
2.7	Key expansion	1
2.8	Block cipher modes of operation – Electronic Codebook Mode (ECB), Cipher Block Chaining Mode (CBC), Cipher Feedback Mode (CFB), Output Feedback Mode (OFB), Counter Mode (CTR).	1
2.9	Stream ciphers – Structure, RC4	1
Module-3 (Public Key Cryptosystems)(7hrs)		
3.1	Public key cryptosystems – Principles, Applications, Requirements, Conventional vs Public key cryptosystems	1

3.2	RSA cryptosystem – Algorithm	1
3.3	RSA Security, Attacks	1
3.4	ElGamal cryptosystem – Algorithm	1
3.5	Diffie-Hellman key exchange – Algorithm, Man-in-the-middle attack	1
3.6	Elliptic Curve Cryptography (ECC) – ElGamal ECC	1
3.7	Key exchange using ECC	1
Module-4 (Message Integrity and Authentication) (6 hrs)		
4.1	Hash functions – Security requirements, Secure Hash Algorithm (SHA-512)	1
4.2	Message Authentication Code (MAC) – Requirements, Uses	1
4.3	Hash-based MAC (HMAC), Cipher-based MAC (CMAC)	1
4.4	Digital signatures – Attacks, Forgeries, Requirements, Direct Vs Arbitrated digital signatures	1
4.5	RSA digital signature, ElGamal digital signature	1
4.6	Digital Signature Standard (DSS)	1
Module-5 (Key Distribution and System Security) (7hrs)		
5.1	Key management – Distribution of secret keys using symmetric and asymmetric encryption	1
5.2	Distribution of public keys	1
5.3	System security – Intruders, Intrusion detection techniques	1
5.4	Password management	1
5.5	Malicious software – Viruses, Related threats	1
5.6	Virus countermeasures	1
5.7	Distributed Denial of Service (DDoS) attacks – Types, Countermeasures	1

AIT 443	CONCEPTS IN COMPILER DESIGN	Category	L	T	P	Credit
		PEC	2	1	0	3

Preamble:

The purpose of this course is to create awareness among students about the phases of a compiler and the techniques for designing a compiler. This course covers the fundamental concepts of different phases of compilation such as lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation. Students can apply this knowledge in design and development of compilers.

Prerequisite: Sound knowledge in Data Structures and Programming Concepts.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the phases in compilation process (lexical analysis, syntax analysis, semantic analysis, intermediate code generation, code optimization and code generation) and model a lexical analyzer **(Cognitive Knowledge Level: Apply)**
CO2	Model language syntax using Context Free Grammar and construct Top-Down Parsers. (**Cognitive Knowledge Level: Apply)**
CO3	Compare different types of parsers (Bottom-up and Top-down) and construct parser for a given grammar **(Cognitive Knowledge Level: Apply)**
CO4	Build Syntax Directed Translation for a context free grammar, compare various storage allocation strategies and classify intermediate representations **(Cognitive Knowledge Level: Apply)**
CO5	Illustrate code optimization and code generation techniques in compilation **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓	✓							✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓

CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment - Test : **25 marks**

Continuous Assessment - Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module - 1 (Introduction to compilers and lexical analysis)

Analysis of the source program - Analysis and synthesis phases, Phases of a compiler. Compiler writing tools.

Lexical Analysis - Role of Lexical Analyser, Input Buffering, Specification of Tokens, Recognition of Tokens.

Module - 2 (Introduction to Syntax Analysis)

Role of the Syntax Analyser- Introduction to Context Free Grammars -Parse Trees and DerivationsAmbiguous grammar-Eliminating ambiguity, left recursion and Left factoring the grammar.

Top-Down Parsing - Recursive Descent parsing, First and Follow, Predictive Parsing table constructor for LL(1) grammar.

Module - 3 (BottomUp Parsing)

Bottom-up parsing - Shift Reduce Parsing,LR parsing - algorithm and working, LR(0) Canonical items, Constructing LR(0) and SLR Parsing Tables, LR(1) Canonical items ,Constructing Canonical and LALR Parsing Tables.

Module - 4 (Syntax directed translation and Intermediate code generation)

Syntax directed translation - Syntax directed definitions, S-attributed definitions, L-attributed definitions, Storage-allocation strategies.

Intermediate Code Generation - Intermediate languages, Graphical representations, Three-Address code, Quadruples, Triples.

Module 5 – (Code Optimization and Generation)

Code Optimization - Principal sources of optimization, Machine dependent and machine independent optimizations, Basic Blocks and Program Flow Graph: with Examples, Local and global optimizations.

Code generation - Issues in the design of a code generator, A simple code generator.

Text Books

1. Aho A.V., Ravi Sethi and D. Ullman. Compilers – Principles Techniques and Tools, Addison Wesley, 2006.

Reference Books

1. D.M.Dhamdhere, System Programming and Operating Systems, Tata McGraw Hill & Company, 1996.
2. Kenneth C. Louden, Compiler Construction – Principles and Practice, Cengage Learning Indian Edition, 2006.
3. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company,1984.

4. John E Hopcroft, Jeffrey D Ullman,IntroductionTo Automata Theory, Languages And Computation

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1) Explain the phases of a compiler with a neat diagram.

2) Define a token. Identify the tokens in the expression a := b + 10.

Course Outcome 2 (CO2):

1) Illustrate the process of eliminating ambiguity, left recursion and left factoring the grammar.

2) Is the following grammar ambiguous? If so, eliminate ambiguity.

E→E + E | E*E |(E) | id

3) Design a predictive parser for the grammar

E→E + T | T

T→T*F | F

F→(E) | id

Course Outcome 3 (CO3):

1. What are the different parsing conflicts in the SLR parsing table?
2. Construct canonical LR(0) collection of items for the grammar below.

S → L = R

S → R

L → * R

L → id

R → L

Also identify a shift reduce conflict in the LR(0) collection constructed above.

Course Outcome 4 (CO4):

1. Write the quadruple and triple representation of the following intermediate code

R1 = C * D

R2 = B + R1

A = R2

B[0] = A

2. Differentiate S-attributed Syntax Directed Translation(SDT) and L-attributed SDT. Write S - attributed SDT for a simple desktop calculator
3. Discuss the different storage allocation strategies.

Course Outcome 5 (CO5):

1. List out the examples of function preserving transformations.
2. What are the actions performed by a simple code generator for a typical three-address statement of the form x: = y op z.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION , MONTH & YEAR

Course Code: AIT 443

Course Name: Concepts In Compiler Design

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Specify the analysis and synthesis parts of compilation.
2. Define the terms token, lexemes, and patterns with examples.
3. Is the grammar S --> S | (S) S / Ɛ ambiguous? Justify your answer.
4. What is left recursive grammar? Give an example. What are the steps in removing left recursion?
5. Compare different bottom-up parsing techniques.
6. What are the possible actions of a shift reduce parser.

7. Differentiate synthesized and inherited attributes with examples.

8. Translate a[i] = b * c – b * d, to quadruple.

9. What is the role of peephole optimization in the compilation process

10. What are the issues in the design of a code generator

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the different phases of a compiler with a running example. **(9)**

(b) List and explain any three compiler construction tools. **(5)**

OR

12. (a) What is a regular definition? Give the regular definition of an unsigned integer **(7)**

(b) Express the role of transition diagrams in recognition of tokens. **(7)**

13. (a) What is Recursive Descent parsing? List the challenges in designing such a parser? **(4)**

(b) Consider the following grammar **(10)**

E-⟶E or T | T

T⟶ T and F |F

F⟶not F | (E) | true | false

(i) Remove left recursion from the grammar.

(ii) Construct a predictive parsing table.

(iii) Justify the statement “The grammar is LL (1)”.

OR

14. (a) What is Recursive Descent parsing? List the problems in designing such a parser **(4)**

(b) Design a recursive descent parser for the grammar S→cAd, A→ab/ b **(5)**

Find the FIRST and FOLLOW of the non-terminals S, A and B in the grammar **(5)**

S→aABe
A→Abc | b
B→d

15. (a) Construct the LR(0) set of items and their GOTO function for the grammar **(10)**

S→S S + | S S * | a

(b) Is the grammar SLR? Justify your answer **(4)**

OR

16. (a) Identify LR(1) items for the grammar **(7)**

S→ CC
C→ cC | d

(b) Construct LALR table for the above grammar **(7)**

17. (a) Design a Syntax Directed Translator(SDT) for the arithmetic expression (4 * 7 + 19) * 2 and draw an annotated parse tree for the same. **(8)**

(b) Consider the grammar with following translation rules and E as the start symbol **(6)**

E → E1 # T {E.value=E1.value x T.value ;}
| T{E.value=T.value ;}
T → T1 &F{ T.value=T1.value + F.value ;}
| F{T.value= F.value ; }
F → num {F.value=num. lvalue ;}

Compute E.value for the root of the parse tree for the expression

2#3 & 5# 6 &7

OR

18.	(a)	Write Syntax Directed Translator (SDT) and parse tree for infix to postfix translation of an expression.	**(8)**
	(b)	Explain the storage allocation strategies.	**(6)**
19.	(a)	Describe the principal sources of optimization	**(7)**
	(b)	Illustrate the optimization of basic blocks with examples.	**(7)**

OR

20.	(a)	Write the Code Generation Algorithm and explain the *getreg* function	**(6)**
	(b)	Generate target code sequence for the following statement *d := (a-b)+(a-c)+(a-c).*	**(8)**

Teaching Plan

No	Contents	No. of Lecture Hours
Module - 1(Introduction to Compilers and lexical analyzer) (7 hours)		
1.1	Introduction to compilers, Analysis of the source program	1 hour
1.2	Phases of the compiler – Analysis Phases	1 hour
1.3	Phases of the Compiler - Synthesis Phases	1 hour
1.4	Compiler writing tools	1 hour
1.5	The role of Lexical Analyzer, Input Buffering	1 hour
1.6	Specification of Tokens	1 hour
1.7	Recognition of Tokens	1 hour
Module - 2(Introduction to Syntax Analysis) (7 hours)		

2.1	Role of the Syntax Analyzer- Introduction to Context Free Grammars	1 hour
2.2	Parse Trees and Derivations	1 hour
2.3	Ambiguous grammar- Eliminating ambiguity	1 hour
2.4	Left recursion and left factoring the grammar	1 hour
2.5	Top Down Parsing- Recursive Descent Parsing	1 hour
2.6	First and Follow	1 hour
2.7	Predictive Parsing table constructor for LL (1) grammar	1 hour
Module - 3(Bottom up parsing) (8 hours)		
3.1	Bottom-up parsing - Shift Reduce Parsing	1 hour
3.2	LR parsing - algorithm and working- Lecture 1	1 hour
3.3	LR (0) canonical items	1 hour
3.4	Constructing LR (0) Parsing Tables	1 hour
3.5	Constructing SLR Parsing Tables	1 hour
3.6	LR(1) Canonical items	1 hour
3.7	Constructing Canonical LR Parsing Tables	1 hour
3.8	Constructing LALR Parsing Tables	1 hour
Module - 4 (Syntax Directed Translation and Intermediate code Generation) (7 hours)		
4.1	Syntax directed definitions	1 hour
4.2	S- attributed definitions, L- attributed definitions	1 hour
4.3	Storage- allocation strategies- Lecture 1	1 hour
4.4	Storage- allocation strategies- Lecture 1	1 hour
4.5	Intermediate languages, Graphical representations	1 hour
4.6	Three-Address code	1 hour
4.7	Quadruples, Triples	1 hour
Module - 5(Code Optimization and Generation) (7 hours)		
5.1	Principal sources of optimization- Introduction	1 hour
5.2	Machine dependent optimizations	1 hour

5.3	Machine independent optimizations	1 hour
5.4	Basic Blocks and Program Flow Graph: with Examples	1 hour
5.5	Local optimization and Global optimization	1 hour
5.6	Issues in the design of a code generator	1 hour
5.7	Design of a simple code generator.	1 hour

ADT 453	INFORMATION EXTRACTION AND RETRIEVAL	Category	L	T	P	Credit
		PEC	2	1	0	3

Preamble:

Information Extraction and Retrieval is a course that focuses on the techniques and methodologies for extracting relevant information from large volumes of unstructured data and retrieving it efficiently. The course explores various approaches, algorithms, and tools used to process and analyze textual data, enabling students to gain insights and make informed decisions. Topics covered include text mining, information retrieval models, document indexing, query processing, and evaluation techniques. Through this course, students will develop the skills necessary to extract valuable information from diverse sources and build effective retrieval systems to support information needs

Prerequisite: Basic knowledge in machine learning.

Mapping of course outcomes with program outcomes

CO1	Understand information retrieval fundamentals.**(Cognitive Knowledge Level: Understand)**
CO2	Apply classic IR models And Analyze IR model effectiveness.**(Cognitive Knowledge Level: Apply)**
CO3	Construct keyword-based queries and Apply Boolean query approaches**(Cognitive Knowledge Level: Apply)**
CO4	Describe text and multimedia languages. Implement efficient indexing techniques and search algorithms**(Cognitive Knowledge Level: Apply)**
CO5	Apply information extraction techniques and Evaluate chunking and expansion**(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓

CO2	✓	✓	✓	✓								✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	**30**	**30**	**30**
Apply	**70**	**70**	**70**
Analyze			
Evaluate			
Create			

\

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Introduction and Basic Concepts)

Introduction: Information versus Data Retrieval, IR: Past, present, and future. Basic concepts: The retrieval process, logical view of documents. Modeling: A Taxonomy of IR models, ad-hoc retrieval and filtering

Module – 2 (Classic IR Models and Retrieval Evaluation)

Classic IR models, Alternative Set theoretic models, Alternative algebraic models, Alternative probabilistic models, Structured text retrieval models, models for browsing. Retrieval evaluation: Performance evaluation of IR: Recall and Precision, other measures

Module – 3 (Reference Collections and Query Languages)

Reference Collections such as TREC, CACM, and ISI data sets. Query Languages: Keyword based queries, single word queries, context queries, Boolean Queries, Query protocols.

Module– 4 (Text and Multimedia Languages, Indexing, and Searching)

Text and Multimedia Languages and properties, Metadata, Text formats, Markup languages, Multimedia data formats, Text Operations-Document preprocessing, Document Clustering, Text Compression,Comparing text compression techniques. Indexing and searching -Inverted files, other indices for text, Sequential searching-Brute force, knuth morris pratt, Pattern matching-string matching allowing errors.

Module 5 (Web based Information Extraction)

Web search basics - Background and history , Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation, Near-duplicates and shingling
Web crawling and indexes – Crawling, Distributing indexes, Connectivity servers
Link analysis - The Web as a graph, PageRank

Text Book

1. An Introduction to Information Retrieval, Christopher D. Manning,Prabhakar Raghavan,Hinrich Schütze, Cambridge University Press
2. R. Baeza-Yates and B. R. Neto: Modern Information Retrieval:, Pearson Education, 2004

Reference Books

1. C.J. van Rijsbergen: Information Retrieval, Butterworths.
2. Introduction to Information Retrieval: Christopher D. Manning, Raghavan, and Schutze. 2000.
3. Information Retrieval: Algorithms and Heuristics (The Information Retrieval Series:2nd Edition): David A. Grossman and Ophir Frieder.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. What are the key differences between information retrieval and data retrieval? Provide examples to illustrate their distinctions.
2. Discuss the evolution of information retrieval over time.

Course Outcome 2(CO2):

1. Compare and contrast the strengths and limitations of set-theoretic and probabilistic IR models, and discuss real-world scenarios where one model may outperform the other.

2. Let X t be a random variable indicating whether the term t appears in a document. Suppose we have | R | relevant documents in the document collection and that Xt = 1 in s of the documents. Take the observed data to be just these observations of X t for each document in R. Show that the MLE for the parameter p t = P (Xt = 1 | R = 1, ~ q) , that is, the value for p t which maximizes the probability of the observed data, is p t = s/ | R | .
3. What is the relationship between the value of F1 and the break-even point?

Course Outcome 3(CO3):

1. Construct a Boolean query that retrieves documents containing the words "machine learning" and "classification" but excludes any documents with the word "neural networks" present.
2. Explain the significance of reference collections in information retrieval research, and describe the characteristics and importance of well-known collections like TREC and CACM.

Course Outcome 4(CO4): .

1. Describe index compression techniques?
2. How can clustering classified using statistical techniques.? Describe in detail.

Course Outcome 5(CO5):

1. Define web search and web search engine.
2. Explain crawling and types of crawling?

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: ADT 453

Course Name: INFORMATION EXTRACTION AND RETRIEVAL

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Give the historical view of Information Retrieval.

2. What are the components of IR?

3. Why the Classic IR might lead to poor retrieval?

4. What is the relationship between the value of F1 and the break-even point?

5. Explain the concept of a Boolean query. Discuss the advantages and limitations of using sequential searching for information retrieval.

6. List out the query protocols.

7. Write notes on parallel inverted files.

8. What are the desirable properties of clustering algorithm

9. What are the basic rules for Web crawler operation

10. Define web search and web search engine.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the Information Retrieval in detail **(7)**

(b) Explain the influence of AI in information retrieval **(7)**

OR

12. (a) Discuss the evolution of information retrieval over time. **(7)**

(b) What are the key differences between information retrieval and data retrieval? Provide examples to illustrate their distinctions. **(7)**

13. (a) Compare and contrast the strengths and limitations of set-theoretic and probabilistic IR models, and discuss real-world scenarios where one model may outperform the other. **(8)**

(b) How can you find similarity between doc and query in probabilistic principle Using Bayes' rule? **(6)**

OR

14. (a) Explain in detail about vector-space retrieval models with an example **(7)**

(b) Write the formal characterization of IR Models **(7)**

15. (a) Construct a Boolean query that retrieves documents containing the words "machine learning" and "classification" but excludes any documents with the word "neural networks" present. **(6)**

(b) Explain keyword-based query in detail **(8)**

OR

16. (a) Explain the significance of reference collections in information retrieval research, and describe the characteristics and importance of well-known collections like TREC and CACM. **(14)**

17. (a) How can clustering classified using statistical techniques.? Describe in detail. **(7)**

(b) Discuss Brute force algorithm. **(7)**

OR

18. (a) Describe Text compression techniques? **(6)**

(b) Explain knuth morris pratt algorithm **(8)**

19. (a) What are the benefits of distributing Web search indexes? Explain the challenges and solutions for distributing indexes in a scalable and fault-tolerant way. **(7)**

(b) Explain crawling and types of crawling? **(7)**

OR

20. (a) Briefly explain web search architectures? **(9)**

(b) Explain page rank **(5)**

Teaching Plan

No	Contents	No. of Lecture Hours (35 hrs)
Module-1(Introduction) (4 hours)		
1.1	Information versus Data Retrieval, IR: Past, present, and future.	1 hour
1.2	Basic concepts: The retrieval process, logical view of documents.	1 hour
1.3	Modeling: A Taxonomy of IR models	1 hour
1.4	Ad-hoc retrieval and filtering	1 hour
Module-2 (IR Models and Retrieval Evaluation) (10 hours)		
2.1	Classic IR models	2 hour

2.2	Alternative set theoretic models	1 hour
2.3	Alternative algebraic models	2 hour
2.4	Alternative probabilistic models	2 hour
2.5	Structured text retrieval models	1 hour
2.6	Models for browsing	1 hour
2.7	Retrieval evaluation: Performance evaluation of IR: Recall and Precision, other measures	1 hour
Module-3 (Reference Collections and Query Languages) (5 hours)		
3.1	Reference Collections such as TREC, CACM, and ISI data sets.	2 hour
3.2	Query Languages: Keyword based queries, single word queries, context queries, Boolean Queries	2 hour
3.3	Query protocols	1 hour
Module-4 (Text and Multimedia Languages, Indexing, and Searching) (9 hours)		
4.1	Text and Multimedia Languages and properties- Metadata, Text formats, Markup languages, Multimedia data formats	2 hour
4.2	Text Operations-Document preprocessing, Document Clustering,	2 hour
4.3	Text Compression,Comparing text compression techniques.	2 hour
4.4	Indexing and searching -Inverted files, other indices for text,	1 hour
4.5	Sequential searching-Brute force, knuth morris pratt	1 hour
4.6	Pattern matching-String matching allowing errors	1 hour
Module-5 (Fuzzy Applications) (7 hours)		
5.1	Web search basics - Background and history , Web characteristics, Advertising as the economic model	1 hour
5.2	The search user experience, Index size and estimation, Near-duplicates and shingling	2 hour
5.3	Web crawling and indexes – Crawling, Distributing indexes, Connectivity servers	2 hour
5.4	Link analysis - The Web as a graph, PageRank	2 hour

CST463	WEB PROGRAMMING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course helps the learners to understand the web programming concepts. It includes the essential frontend and backend technologies needed for the development of web applications. The learners will have an opportunity to gain necessary web development skills such as HTML, CSS, JavaScript, PHP, MySQL integration, JSON and Laravel framework.

Prerequisite: Knowledge of Programming is required.

Course Outcomes: After the completion of the course the student will be able to

CO1	Use HyperText Markup Language (HTML) for authoring web pages and understand the fundamentals of WWW. **(Cognitive Knowledge Level: Understand)**
CO2	Construct and visually format responsive, interactive web pages using CSS and JavaScript (JS) **(Cognitive Knowledge Level: Apply)**
CO3	Construct websites using advanced sever side programming tool PHP **(Cognitive Knowledge Level: Apply)**
CO4	Develop dynamic web applications using PHP and perform MySQL database operations. **(Cognitive Knowledge Level: Apply)**
CO5	Explain the importance of object exchange formats using JSON and the MVC based web application development frameworks (Laravel) **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓							✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓

CO5	✓	✓			✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks.

First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of thesyllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from thecompleted modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have a maximum of 2 subdivisions and carries 14 marks.

Syllabus

Module – 1 (WWW, HTML)

Introduction to the Internet & WWW: Evolution of Internet & World Wide Web- Web Basics, URI's & URL-MIME.

Introduction to HTML5: Structuring & editing an HTML5 document, Fundamentals of HTML - Headings-Hyper Links- Images - Special Characters & Horizontal Rules-Lists- Tables -Forms - Internal Linking- Meta Elements-HTML5 Form input types -Input and Data List Elements and autocomplete attribute- Page Structure Elements -Multimedia-HTML5 Audio & video elements..

Module -2 (CSS, JavaScript)

Introduction to Stylesheets : Introduction to CSS-Basic syntax and structure-Inline Styles, Embedded Style Sheets, Conflict Resolution, Linking External Style Sheets-Exploring CSS Selectors-Properties, values, Positioning Elements: Absolute Positioning, Relative Positioning -

Backgrounds-List Styles-Element Dimensions- Table Layouts-Box Model and Text Flow-div and span -Basics of Responsive CSS, Media port & Media Queries.

Introduction to JavaScript : Introduction to Scripting- Programming fundamentals of JavaScript -Obtaining User Input with prompt Dialogs-Arithmetic-Decision Making -Control Statements -Functions -Arrays -Objects -Document Object Model (DOM) -Form processing

Module- 3 (PHP Basics)

PHP Language Structure: Introduction- **B**uilding blocks of PHP-Variables, Data Types -simple PHP program-Converting between Data Types- Operators and Expressions -Flow Control functions - Control statements- Working with Functions- Initialising and Manipulating Arrays-- Objects-String Comparisons-String processing with Regular Expression

Module -4 (PHP- MySQL, JSON)

Advanced PHP: Form processing and Business Logic-Cookies- Sessions & MySQL Integration-Connecting to MySQL with PHP- Performing CREATE, DELETE, INSERT, SELECT and UPDATE operations on MySQL table -Working with MySQL data-Reading from Database-Dynamic Content.

Module- 5 (JSON, **Laravel)**

JSON Data Interchange Format: Syntax, Data Types, Object, JSON Schema, Manipulating JSON data with PHP

Web Development Frameworks: Laravel Overview-Features of Laravel-Setting up a Laravel Development Environment-Application structure of Laravel-Routing -Middleware-Controllers-Route Model Binding-Views-Redirections-Request and Responses.

Text Books

1 Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet & World Wide Web How to Program 5th Edition **[Module 1,2,3,4]**

2. Lindsay Bassett, Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON 1st Edition, O'Reilly **[Module 5]**
3. Julie C. Meloni, Pearson -PHP, MySQL & JavaScript All in One, Sams Teach Yourself,5th Ed [**Module 4]**
4. Matt Stauffer," LARAVEL up and Running, A framework for building modern PHP apps"1st Edition, O'REILLY **[Module 5]**

Reference Books

1. Robert W Sebesta, Programming the World Wide Web, 7/e, Pearson Education Inc,8th Edition
2. Larry Ullman, Pearson- PHP 6 and MySQL 5 for Dynamic Web Sites: Visual QuickPro Guide
3. Eric van der Vlist, Danny Ayers, Erik Bruchez, Joe Fawcett, Alessandro Vernet",Wrox-Professional Web 2.0 Programming, Wiley-India edition
4. Web Technologies Black Book 2018(As per Mumbai University Syllabus) HTML, CSS3, JavaScript, iQuery, AJAX,PHP,XML,MVC and Laravel DT Editorial Services (ISBN: 9789386052490)

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Construct a valid HTML document for your personal Profile registration page for a Job Site www.123Jobs.com. Add relevant HTML elements in a table, to accept a minimum of 10 different fields which includes your name, address, phone, email address, your picture, your college; your branch, fields for your personal history (Minimum 3 fields), favourite theory and practical subjects (Checkbox), Username, Password(password)
2. What is MIME? Give the expansion of MIME. List four examples for MIME types. State the reason why MIME type specification is necessary in a request-response transaction between a browser and server.
3. What is codec? Recognize the role of controls attribute in <video> & <audio> tag in HTML. Use the COVID vaccination promotional video 'MySafety.mp4' in a web page with suitable HTML code, 'autoplay' option enabled and displayed in a standard dimension 750 X500.

Course Outcome 2 (CO2):

1. Organize a sample web page for the event 'Raagam2021' at your campus and use embedded Style sheets to apply a minimum 5 styles. State the Style Specification format of embedded style sheets.
2. Write CSS style rules to implement the following in a web page:

   a. to display the content of hyperlinks with yellow background color and in italics

   b. to display the contents of unordered lists in bold and in Arial font

   c. to display a background image titled "birds.jpg" with no tiling.
3. Write the code for an HTML document with embedded JavaScript scripts, which initially displays a paragraph with text "Welcome" and a button titled "Click". When the button is clicked, the message "Hello from JavaScript" in bold should replace the paragraph text

Course Outcome 3 (CO3):

1. Write a PHP program to store the name and roll no of 10 students in an Associative Array and Use foreach loop to process the array and Perform asort, rsort and ksort in the array. Illustrate with suitable output data
2. Design an HTML page which enters a given number, write a PHP program to display a message indicating, whether the number is odd or even, when clicking on the submit button.
3. Write a PHP program to compute the sum of the positive integers up to 100 using do while.

Course Outcome 4 (CO4):

1. Write a PHP form handling program to verify the user authentication credentials of a web page using MySQL connection and store the userid value as a Session variable if the userid is valid.
2. Create a valid HTML document for yourself, including your name, address, and email address. Also add your college; your major and the course. Perform form handling in PHP and process the output using POST method.
3. Write an embedded PHP script which displays the factorial of all numbers from 1 to 10 in a table in the web page. The factorial should be calculated and returned from a function. The table headings should be "Number" and "Factorial"

Course Outcome 5 (CO5):

1. What is Route Model Binding in Laravel? Which types of route model binding are supported in Laravel?
2. Explain how laravel performs route handling using routes calling controller methods?
3. List the data types used in JSON? Explain the use of parse () and stringify() functions in JSON with examples.

Model Question Paper

QP CODE:

Reg No: _____

Name:_____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST463

Course Name: Web Programming

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Define WWW. List any two examples of web server & web browser. Differentiate between URL and a domain?

2. Write the syntax of the URL? Rewrite the default URL of your university website by adding a subdomain named 'Research' and a web page named 'FAQ.html'. Also link this URL through the logo of 'kturesearch.png' placed in a web page. The FAQ page should be opened in a new window.

3. Illustrate the implementation of a JavaScript function greeting () using external .js file, to display a welcome message, when you click on a Button in an HTML page.

4. What are different ways of adjusting spacing in a text with suitable example.

5. Discuss the various CSS style sheet levels with suitable examples. How are conflicts resolved when multiple style rules apply to a single web page element?

6. Describe how input from an HTML form is retrieved in a PHP program, with an example

7. Write a PHP program to check whether a number is prime number or not.

8. Discuss the various steps for establishing PHP-MySQL connection with a MySQL

database ?

9. Describe the schema of a document implemented in JSON with suitable examples

10. Explain the role of Resource controllers in Laravel.

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Design a webpage that displays the following table. **(6)**

Food Item	Recommended Intake			
	age<15		age>15	
	gm	Kcal	gm	Kcal
Cerials	1000	2000	750	1760
NonCerials	450	800	350	600

(b) What is the difference between radio buttons and checkboxes when implemented using HTML? Write HTML code to implement a form which has the following elements: **(8)**

i. A textbox which can accept a maximum of 25 characters
ii. Three radio buttons with valid Label, Names and values
iii. Three check boxes buttons with valid Label, Names and values
iv. A selection list containing four items, two which are always visible
v. A submit button clicking on which will prompt the browser to send the form data to the server "http://www..mysite.com/reg.php" using "POST" method and reset button to clear its contents. You can use any text of your choice to label the form elements.

OR

12. (a) Write the equivalent HTML code to implement the following in a web page: **(6)**
(i) An image titled "birds.jpg" with a height of 100 pixels and width of 200 pixels. If the image cannot be accessed, a message "No image available" should be displayed (ii) A hyperlink to the URL"www.mysite.com/birds.jpg". The hyperlink should have the label "ClickHere".

(b) Create a static HTML document for your portfolio, which includes the following contents: your name, address, Mobile Number and email address. Also add the details about your college, university, your major and the batch **(8)**

of study. Include a picture of yourself and at least one other image (friend/pet/role model) to the document with a short description about that. Add three paragraphs about your personal history, with links to your social media profile. Also create an ordered list for describing your Skill Set & an unordered list showing your Strengths & Weaknesses.

13. (a) Illustrate the usage of JavaScript DOM in event handling and explain any three methods with example. **(8)**

(b) Write CSS and the corresponding HTML code for the following: **(6)**

i. Set the background color for the hover and active link states to "green"
ii. Set the list style for unordered lists to "square".
iii. Set "Flower.png" as the background image of the page and set 3% margin for the pages
iv. Set dashed border for left and right and double border for top & bottom of a table with 2 rows.

OR

14. (a) List the order of precedence of style levels. Organize a sample web page for providing 'KTU BTech Honours Regulation 19' for KTU and use embedded Style sheet to apply minimum 5 styles for list, tables and pages. **(6)**

(b) Illustrate the different ways of Array declaration in JavaScript. Describe the function of the following JavaScript Array object methods with examples. **(8)**
(i) join (ii) slice

15. (a) Explain any six string handling functions used in PHP with example. **(6)**

(b) How does a PHP array differ from an array in C? List the different ways to create an array in PHP with an example. Explain any 4 functions that deals with PHP array. **(8)**

OR

16. (a) During the process of fetching a web page from a web server to a client browser, at what point does an embedded PHP script get executed. What are the two modes that the PHP processor operates in? Explain **(6)**

(b) Why is PHP considered to be dynamically typed? Distinguish between **(8)**

implode and explode function in PHP with suitable examples.

17. (a) Write equivalent PHP statements corresponding to the following: **(8)**

i. Declare an associative array named "ages" to store the key-value pairs ("Alice", 30), ("Bob", 30), ("Harry", 35), ("Mary", 32).

ii. Modify the value associated with the key "Mary" to 28.

iii. Sort the array according to values maintaining the key-value relationships and print the sorted key-value pairs.

iv. The entry identified by the key "Bob"

(b) What are the uses of cookies in web pages? Describe syntax for setting cookies in PHP. How can you access and delete the cookie using setcookie() function? **(6)**

OR

18. (a) Write a PHP form handling program to perform the user registration of any website with a minimum of 5 different fields and insert the data into aMySQL table after establishing necessary connections with the DB, **(8)**

(b) Design the HTML page which enters a given number and embed the PHP code to display a message indicating, whether the number is odd or even, when clicking on the 'CHECK NUMBER' button. **(6)**

19. (a) With a neat diagram, explain about Laravel MVC Framework. **(6)**

(b) Discuss in detail about Laravel's Routing mechanisms. **(8)**

OR

20. (a) Enumerate the data types in JSON. Illustrate the document definition of a 'Student document 'using JSON Schema. **(8)**

(b) Discuss the following in Laravel Views **(6)**

i. Creating & Rendering Views

ii. Passing Data to Views

iii. Sharing Data with All Views

Teaching Plan

No	Contents	No of Lecture Hrs (35 hrs)
Module 1 (7 hours)		
Introduction to Internet and WWW		
1.1	Evolution of Internet &World Wide Web- Web Basics URI's & URL -MIME [Book 1 - Chapter 1]	1
Introduction to HTML5		
1.2	Structuring & editing an HTML5 document- Fundamentals of HTML, Headings- Images [Book 1 - Chapter 2]	1
1.3	Hyper Links, Internal Linking- Lists [Book 1 - Chapter 2]	1
1.4	Special Characters & Horizontal Rules- meta Elements- div and span [Book 1 - Chapter 2]	1
1.5	Tables- Forms [Book 1 - Chapter 2]	1
1.6	HTML5 Form input types, input and data list Elements and autocomplete attributes-Page Structure Elements [Book 1 - Chapter 3]	1
1.7	Multimedia-HTML5 Audio & video elements [Book 1 - Chapter 9]	1
Module 2 (10 hours)		
Introduction to Cascading Style Sheets(CSS)		
2.1	Introduction to CSS3-Basic syntax and structure-Inline Styles [Book 1 - Chapter 4]	1
2.2	Embedded Style Sheets-Linking External Style Sheets [Book 1 - Chapter 4]	1
2.3	Exploring CSS Selectors-Properties-values [Book 1 - Chapter 4]	1
2.4	Positioning Elements: Absolute Positioning- Relative Positioning -Backgrounds- List Styles- Table Layouts [Book 1 - Chapter 4]	1

2.5	Box Model and Text Flow, Basics of Responsive CSS-Media port & Media Queries [Book 1 - Chapter 4]	1
Introduction to JavaScript		
2.6	Introduction to Scripting- Programming fundamentals of JavaScript -Obtaining User Input with prompt Dialogs [Book 1 - Chapter 6]	1
2.7	Arithmetic-Decision Making [Book 1 - Chapter 6]	1
2.8	Control Statements [Book 1 - Chapter 7]- Functions [Book 1 - Chapter 9]	1
2.9	Arrays [Book 1 - Chapter 10] - Objects [Book 1 - Chapter 11]	1
2.10	Document Object Model (DOM)- Form processing [Book 1 - Chapter 12,13]	1
Module 3 (6 hours)		
Introduction to PHP		
3.1	Building blocks of PHP-Variables, Data Types simple PHP program [Book 3- Chapters 4]	1
3.2	Converting between Data Types, Operators and Expressions -Flow Control functions [Book 1- Chapters 19]	1
3.3	Control Statements -Working with Functions [Book 3- Chapters 6]	1
3.4	Initialising and Manipulating Arrays- Objects [Book 1- Chapters 19]	1
3.5	Working with Strings-String processing with Regular expression, Pattern Matching [Book 1- Chapters 19]	1
3.6	Form processing and Business Logic [Book 1- Chapters 19]	1
Module 4 (6 hours)		
PHP -MYSQL		
4.1	Cookies- Sessions [Book 1- Chapters 19]	1
4.2	PHP& MySQL Integration-Connecting to MySQL with PHP . [Book 4- Chapters 18]	1

4.3	Working with MySQL data [Book 4- Chapters 18]	1
4.4	Performing CREATE, DELETE, INSERT operations on MySQL table from PHP Program. [Book 4- Chapters 16]	1
4.5	Performing SELECT and UPDATE operations on MySQL table from PHP Program. [Book 4- Chapters 16]	1
4.6	Building Dynamic Content in PHP application [Book1- Chapter19]	1
Module 5 (6 hours)		
	JSON	
5.1	JSON Data Interchange Format -Syntax, Data Types, Object [Book 2 - Chapters 1-2]	1
5.2	JSON Schema, Manipulating JSON data with PHP [Book 2 - Chapter 3,4]	1
	LARAVEL	
5.3	Laravel Overview- Design Pattern- Laravel Features [Book 4- Chapters 1] Setting up a Laravel Development Environment-Application structure of Laravel [Book 4- Chapters 2]	1
5.4	**Laravel Basics** Routing -middleware - Controllers [Book 4- Chapters 3]	1
5.5	Route Model Binding-Views-Redirections [Book 4- Chapters 3]	1
5.6	**Blade Templating**-echoing data, control structures [Book 4- Chapters 4]	1

CST473	NATURAL LANGUAGE PROCESSING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PEC	2	1	0	3	2019

Preamble: This course enables the learners to understand the concepts of Natural Language Processing. The course covers basic pre-processing steps, language models, text classification using machine learning algorithms, information and relation extraction methods, InformationRetrieval, Question Answer Systems and Machine Translation models. This course enables the students to apply techniques and methods to solve challenging real-world problems in NLP.

Prerequisite: Nil.

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize basic concepts and learning methods for NLP **(Cognitive Knowledge Level: Understand)**
CO2	Demonstrate the relevance of pre-processing methods on text data**(Cognitive Knowledge Level: Apply)**
CO3	Compare different language modelling techniques**(Cognitive Knowledge Level: Apply)**
CO4	Make use of NLP techniques in Text Classification and Information Retrieval**(Cognitive Knowledge Level: Apply)**
CO5	Explain Information Extraction, Relation Detection, QA Systems and Machine Translation**(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											✓
CO2	✓	✓	✓		✓							✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓									✓
CO5	✓											✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**40**	**40**	**40**
Apply	**30**	**30**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests (Average of Internal Tests 1 & 2)	**25 marks**
Continuous AssessmentAssignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Introduction to NLP)

NLP Tasks and Applications, Language-Building Blocks, Challenges of NLP, Machine Learning for NLP – Naïve Bayes Classifier, Logistic Regression, Support Vector Machines, Approaches to NLP-- Heuristics-Based NLP, Machine Learning-based NLP.

Module – 2 (Pre-processing and Representation Models)

NLP System Pipeline--Steps--Data Acquisition, Text Extraction and Clean-up, Pre-processing, Feature Engineering, Modelling, Evaluation, Post-Modelling Phases

Text Representation--Vector Space Models--Basic Vectorization Approaches--One-Hot Encoding, Bag of Words, Bag of N-Grams TF-IDF; Distributed Representations-- Word Embeddings, Doc2Vec.

Module - 3 (Classification and Information Extraction)

Text Classification--Text classification applications – Pipeline for building text classification systems, Naïve Bayes for Sentiment Classification – Naïve Bayes Classifier Training – Optimizing for Sentiment Analysis, Logistic Regression, Support Vector Machine for Text Classification

Information Extraction(IE)—IE Applications – The General Pipeline for IE - Named Entity Recognition(NER), Ambiguity in Named Entity Recognition – NER as Sequence Labeling – Evaluation of NER.

Module - 4 (Relation Detection and Information Retrieval)

Relation Detection and Classification – Supervised Learning Approaches to Relation Analysis – Lightly Supervised Approaches to Relation Analysis – Evaluation of Relation Analysis systems

Information Retrieval – Term weighting and document scoring – Inverted Index – Evaluation of Information Retrieval Systems.

Module - 5 (QA Systems and Machine Translation)

Question-Answering Systems – Factoid Question Answering – Question Processing – Passage Retrieval – Answer Processing – Evaluation of Factoid Answers

Machine Translation – Why Machine Translation is Hard – Classical Machine Translation – Direct Translation – Transfer – Statistical Machine Translation- The Phrase based Translation model – Alignment in MT – Training Alignment Models – Symmetrizing Alignments for Phrase-based MT – Decoding for Phrase-based Statistical MT

Text Books

1. Daniel Jurafsky, James H. Martin , "Speech and Language Processing"(2nd and 3rd editions), Pearson Prentice Hall
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana," Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems " June 2020 Publisher(s): O'Reilly Media, Inc. ISBN: 9781492054054.

Reference Books

1. James Allen, "Natural Language Understanding", Second Edn , Pearson.
2. Christopher Manning and Hinrich Schutze, Statistical Natural Language Processing, MIT Press.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain the fundamental tasks that make up an NLP system.
2. Why is NLP considered a challenging problem domain?
3. The following table shows data about the profile of customers and whether they purchase computers or not. Given this data, use Naïve Bayes Classifier to classify the customer ***X*** (*age = youth, income = medium, student = yes, credit rating = fair*)

RID	age	income	student	credit_rating	Class: buys_computer
1	youth	high	no	fair	no
2	youth	high	no	excellent	no
3	middle_aged	high	no	fair	yes
4	senior	medium	no	fair	yes
5	senior	low	yes	fair	yes
6	senior	low	yes	excellent	no
7	middle_aged	low	yes	excellent	yes
8	youth	medium	no	fair	no
9	youth	low	yes	fair	yes
10	senior	medium	yes	fair	yes
11	youth	medium	yes	excellent	yes
12	middle_aged	medium	no	excellent	yes
13	middle_aged	high	yes	fair	yes
14	senior	medium	no	excellent	no

4. Illustrate how linearly inseparable data can be made linearly separable by suitable mapping using kernel functions.

Course Outcome 2(CO2):

1. Mention two issues associated with sentence segmentation.
2. Show how is lemmatization done using Python Library.
3. Given a dataset of tweets, prepare the data for sentiment analysis by doing the following operations: conversion to lower casing, removal of punctuations, removal of stop-words, stemming, lemmatization, removal of emojis and removal of URLs. (Assignment Question)

Course Outcome 3(CO3):

1. Compare Bag-of-Words model and Bag-of-n-gram model.
2. Illustrate how TF-IDF model is used to represent text. Mention the advantage of TF-IDF over other models.
3. A corpus of data is given below :

D1	Dog bites man.
D2	Man bites dog.
D3	Dog eats meat.
D4	Man eats food.

Use one hot-encoding and Bag-of-words models to represent “dog bites man”.

Using the toy corpus given above, represent the sentence “Dog and Man eat meat” with TF-IDF model. Use python code for implementation. (Assignment Question)

Course Outcome 4(CO4): .

1. Given the following data about documents and contents, use tf-idf document scoring method to retrieve the document for the query "best game"

Doc 1	The game was so exciting. The players excelled in every department of the game.
Doc 2	It was an excellent game.
Doc 3	The game was not good. The moves were boring

2. A corpus of data is available from a social media platform that represents review of books. How can Naïve Bayes Classifier be used for sentiment analysis of thereviews? What changes can be made to this classifier to make it tuned for sentiment analysis.
3. Use python library to implement sentiment analysis of review of a book, given a toy corpus data set given below. (Assignment Question)

Document	Category
just plain boring	Negative
entirely predictable and lacks energy	Negative
no surprises and very few laughs	Negative
very powerful book	Positive
the best book of the summer	Positive

Course Outcome 5(CO5):

1. Explain lightly supervised approaches to relational analysis.

2. Explain a statistical algorithm for word alignment in Machine Translation.

Model Question Paper

QP CODE:

Reg No: _____

Name:_____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST473

Course Name: Natural Language Processing

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Differentiate information extraction and information retrieval.

2. State Bayes' Theorem.

3. List three preprocessing steps that are necessary for an HTML file.

4. Differentiate CBOW and Skipgram models

5. Explain the role of support vectors in SVM Classification.

6. Explain challenges in Name Entity Recognition.

7. How is a Relational Analysis System evaluated?

8. Explain the need for an inverted index in an information retrieval system. Are there any more efficient data structures that serve the same purpose.

9. How do you extract answers to DEFINITION questions?

10. What are the components that make up a noisy channel model of statistical Machine Translation?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) How is classification done by SVM on linearly separable data? **(8)**

(b) What is a kernel function? What is the need for a kernel function? Can a kernel function be replaced by an ordinary mapping function? **(4)**

(c) Explain Heuristic-based NLP. **(2)**

OR

12. (a) Illustrate the steps involved in classification in Naïve Bayes Classifier. **(8)**

(b) Explain the fundamental tasks that make up an NLP system. **(6)**

13. (a) Supposing that a set of social media posts' dataset is available to do sentiment analysis. What pre-processing steps need to be done in order to use the data for generating a language model? Illustrate. **(8)**

(b) Illustrate Bag-of-ngrams model with an example. **(6)**

OR

14. (a) Explain the concept of word embeddings as a model for text representation. **(6)**

(b) Compare word embeddings model with vectorization approaches. **(4)**

(c) Explain the concept of feature engineering in NLP Systems. **(4)**

15. (a) 1. Given the following data about movie review and its classification, classify "predictable with no fun" to one of the classes using Naïve Bayes Classifier. **(10)**

Document	Category
just plain boring	Negative
entirely predictable and lacks energy	Negative
no surprises and very few laughs	Negative
very powerful	Positive
the most fun film of the summer	Positive

(b) Explain challenges in Name Entity Recognition. **(4)**

OR

16. (a) Explain Logistic Regression for Text Classification. **(6)**

(b) Explain Name Entity Recognition using Sequence Labeling. **(8)**

17. (a) Explain supervised approach to relation analysis. What are its limitations? **(10)**

(b) How is term selection done for indexing? **(4)**

OR

18. (a) Given the following data about documents and contents, use tf-idf document scoring method to retrieve the document for the query "sweet love". **(10)**

Doc 1	Sweet sweet nurse! Love
Doc 2	Sweet sorrow
Doc 3	How sweet is love?
Doc 4	Nurse!

(b) Explain the approaches to evaluate a relation analysis system. **(4)**

19. (a) Explain the phases of a factoid question-answering system. **(8)**

(b) Give an algorithm for word alignment in Machine Translation. **(6)**

OR

20. (a) How is decoding done in a Phrase-based Statistical Machine Translation System? **(10)**

(b) Explain the concept of Mean Reciprocal Rank. **(4)**

Teaching Plan

No	Contents	No of Lecture Hrs: 35
Module 1 : Introduction to NLP (7 hours)		
1.1	Introduction to NLP – Tasks and Applications	1
1.2	Language – Building Blocks, Challenges of NLP	1
1.3	Approaches to NLP - Heuristics-Based NLP, Machine Learning for NLP	1
1.4	Machine Learning for NLP – Naïve Bayes Classifier	1
1.5	Logistic Regression	1
1.6	Support Vector Machines – Linearly Separable Data	1
1.7	Support Vector Machines – Linearly Inseparable Data	1
Module 2 : Pre-processing and Representation Models(7 hours)		
2.1	NLP System Pipeline – Stages – Overview, Data Acquisition	1
2.2	NLP System Pipeline – Text Extraction and Cleanup	1
2.3	NLP System Pipeline – Preprocessing - Sentence segmentation, Word tokenization, Stemming and lemmatization	1
2.4	Feature Engineering, Model Building, Evaluation – Metrices, Post-modeling phase	1
2.5	Text Representation – Vector Space Model, Vectorization Approaches – One hot encoding, Bag of words	1
2.6	Bag of n-grams, TF-IDF	1
2.7	Word Embeddings – Word2Vec- CBOW, SkipGram models	1
Module 3: Classification and Information Extraction(7 hours)		
3.1	Text Classification--Text classification applications – Pipeline for building text classification systems	1
3.2	Sentiment Analysis using Naïve Bayes Classifier	1
3.3	Case Studies for Text Classification using Logistic Regression and	1

	Support Vector Machines	
3.4	Information Extraction (IE) and Applications, IE Tasks and the IE Pipeline	1
3.5	Named Entity Recognition (NER) – Ambiguity in NER	1
3.6	NER as Sequence Labeling	1
3.7	Evaluation of NER, Practical NER Systems	1
Module 4 : Relation Detection and Information Retrieval(5 hours)		
4.1	Relation Detection and Classification – Supervised Learning Approaches to Relation Analysis	1
4.2	Relation Detection and Classification – Lightly Supervised Approaches to Relation Analysis	1
4.3	Relation Detection and Classification -Evaluation of Relation Analysis systems	1
4.4	Information Retrieval – Term weighting and document scoring	1
4.5	Inverted Index, Evaluation of Information-Retrieval Systems	1
Module 5 : QA Systems and Machine Translation (9 hours)		
5.1	Question-Answering Systems – Factoid Question Answering, Question Processing	1
5.2	Passage Retrieval	1
5.3	Answer Processing, Evaluation of Factoid Answers	1
5.4	Machine Translation – Why Machine Translation is Hard	1
5.5	Classical Machine Translation	1
5.6	Statistical Machine Translation	1
5.7	The Phrase based Translation model	1
5.8	Alignment in Machine Translation	1
5.9	Decoding for Phrase-based Statistical MT	1

OPEN ELECTIVE

CST415	INTRODUCTION TO MOBILE COMPUTING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The purpose of this course is to prepare learners to understand the functionalities and design considerations of mobile computing. The course content is designed to cover the mobile computing architecture, features of different communication systems and major elements of mobile security and next generation computer systems. This course enables the learners to acquire advanced concepts on mobile and ad-hoc networks.

Prerequisite: A good knowledge of data communication and computer networks.

Course Outcomes: After the completion of the course the student will be able to

CO#	Course Outcomes
CO1	Describe the mobile computing applications, services, design considerations and architectures(**Cognitive knowledge: Understand**)
CO2	Identify the technology trends for cellular wireless networks**(Cognitive knowledge:Understand)**
CO3	Summarize the Short Messaging Service and General Packet Radio Service **(Cognitive knowledge: Understand)**
CO4	Outline the LAN technologies used in mobile communication **(Cognitive knowledge: Understand)**
CO5	Describe the security protocols and apply suitable security algorithm to secure the communication **(Cognitive knowledge: Apply)**
CO6	Explain the fundamental concepts of next generation mobile networks**(Cognitive knowledge: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓
CO6	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			

Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance : **10 marks**

Continuous Assessment Test : **25 marks**

Continuous Assessment Assignment : **15 marks**

Internal Examination Pattern:

Each of the two internal examinations shall be conducted for 50 marks. First series test shall be conducted preferably after completing the first half of the syllabus and the second seriestest shall be conducted preferably after completing the remaining part of the syllabus. There shall be two parts for the question paper: Part A and Part B. Part A shall contain five questions (preferably, two questions each from the fully completed modules and one question from the partly covered module), having three marks for each question adding up to 15 marks for part A. A student is expected to answer all questions from Part A. Part B shall contain seven questions (preferably, three questions each from the fully completed modules and one questionfrom the partially completed module), each having seven marks. Out of the seven questions, a student is expected to answer any five.

End Semester Examination Pattern:

There shall be two parts; Part A and Part B. Part A shall contain 10 questions with 2 questions from each module, having 3 marks for each question. A student is expected to answer all questions from Part A. Part B shall contain 2 questions from each module, out of which a student is expected to answer any one. Each question shall have a maximum of two sub- divisions and shall carry 14 marks.

Syllabus

Module-1 (Mobile Computing Architecture)

Introduction to mobile computing – Functions, Devices, Middleware and gateways, Applications and services, Limitations. Mobile computing architecture – Internet: The ubiquitous network, Three-tier architecture, Design considerations for mobile computing.

Module-2 (Communication Systems)

Mobile computing through telephony - Evolution of telephony, Multiple access procedures - Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Space Division Multiple Access (SDMA). Satellite communication systems – Basics, Applications, Geostationary Earth Orbit (GEO), Low Earth Orbit (LEO), Medium Earth Orbit (MEO), Satellitephones. Mobile computing through telephone – Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application. Global System for Mobile Communication (GSM) - Introduction, Architecture, Entities, Call routing, Mobility management, Frequency allocation, Authentication and security.

Module-3 (Short Messaging Service and General Packet Radio Service)

Short Message Service (SMS) – Strengths, Architecture, Value added services, Accessing the SMS bearer. General Packet Radio Service (GPRS) – Architecture, Network operations, Data services, Applications, Limitations, Billing and charging.

Module-4 (Wireless Local Area Networks)

Wireless Local Area Network (WLAN) - Advantages, Evolution, Applications, Architecture, Mobility, Security, Deploying WLAN. Wireless Local Loop (WLL) – Architecture. High Performance Radio Local Area Network (HIPERLAN). WiFi Vs 3G.

Module-5 (Mobile Security and Next Generation Networks)

Security issues in mobile computing - Information security, Security techniques and algorithms, Security protocols. Next generation networks – The Converged Scenario, Narrowband to broadband, Orthogonal Frequency Division Multiplexing (OFDM), Multi Protocol Label Switching (MPLS), Wireless Asynchronous Transfer Mode (WATM), Multimedia broadcast services.

Text Books

1. Asoke K. Talukder, Hasan Ahmad, Roopa R Yavagal, Mobile Computing Technology- Application and Service Creation, 2nd Edition, McGraw Hill Education.
2. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009.

Reference Books

1. Andrew S. Tanenbaum, Computer Networks, 6/e, PHI.
2. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.
3. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning.

Course Level Assessment Questions

Course Outcome 1 CO1):

1. Describe the design considerations in mobile computing.
2. Give five examples of mobile computing applications.

Course Outcome 2 (CO2):

1. Draw a call flow diagram for a theatre ticket booking system.
2. Illustrate the GSM architecture with figure.

Course Outcome 3 (CO3):

1. Illustrate the billing and charging services in GPRS.
2. Describe the SMS architecture.

Course Outcome 4 (CO4):

1. Compare IEEE 802.11, HIPERLAN with respect to their ad-hoc capabilities.
2. Discuss the security mechanism used in WLAN.

Course Outcome 5 (CO5):

1. With the help of a suitable example, show the working of Diffie-Hellman key exchange algorithm.
2. Bob chooses 7 and 11 as two prime numbers and chooses e as 13. Find an appropriate value for d and decrypt the plaintext 5 send by Alice to Bob.
3. Describe the security issues in mobile computing.

Course Outcome 6 (CO6):

1. Describe WATM and Multimedia broadcast services.
2. Describe the significance of Orthogonal Frequency Division Multiplexing (OFDM) in next generation networks.

Model Question Paper

QP CODE: **PAGES: 3**

Reg No:_____
Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST415

Course Name : INTRODUCTION TO MOBILE COMPUTING

Max Marks: 100 **Duration: 3 Hours**

PART-A
(Answer All Questions. Each question carries 3 marks)

1. Explain the different types of middleware and gateways required in mobile computing.
2. List any six limitations of mobile computing.
3. Compare and contrast the satellite systems – GEO, LEO and MEO.
4. How is frequency allocation done in GSM?
5. What are the various strengths of SMS?
6. How is billing and charging done in GPRS?
7. What are the different types of Wireless LANs?
8. Describe the architecture of a Wireless Local Loop.
9. Explain the key features of TLS protocol.
10. How are attacks classified?

(10x3=30)

Part B
(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe any four mobile computing functions. **(4)**

(b) Explain the three-tier architecture of mobile computing with figure. **(10)**

OR

12. (a) Describe the significance and functions of core, edge and access network. **(6)**

(b) Explain the terms (i) Client Context Manager (ii) Policy Manager (iii) Security Manager (iv) Adaptability Manager **(8)**

13. (a) Why is multiple access important? With the help of suitable examples, explain the various multiple access techniques. **(7)**

(b) Describe the different algorithms used for security and authentication in GSM. **(7)**

OR

14. (a) Show how call routing is done in GSM. Give an example. **(7)**

(b) Explain the process of handover. How does handover differ from roaming? **(7)**

15. (a) With the help of neat sketches, explain the difference between Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages. **(6)**

(b) Explain the network operations in GPRS. **(8)**

OR

16. (a) How does operator-centric pull differ from operator-independent push and pull? **(7)**

(b) Describe the data services and applications of GPRS. **(7)**

17. (a) Compare the HIPERLAN and OSI layered architecture. **(4)**

(b) Explain the 802.11 architecture. **(10)**

OR

18. (a) Compare 3G and WiFi. **(7)**

(b) Explain the HIPERLAN communication models with suitable diagrams. **(7)**

19. (a) Given p = 7, q = 17 and e = 5. Find the value of d and also encrypt the message P = 65 using RSA. **(7)**

(b) Explain the role of MPLS in service provisioning. **(7)**

OR

20. (a) With the help of a suitable example, show the working of Diffie-Hellman key exchange algorithm. **(7)**

(b) Explain the features of any three multimedia broadcast services. **(7)**

TEACHING PLAN

No	Contents	No.of Lecture Hrs (35 hrs)
Module-1 (Mobile Computing Architecture) (6 hrs)		
1.1	Introduction to mobile computing – Functions, Devices, Middleware and gateways	1
1.2	Applications, services, limitations, Internet: The ubiquitous network	1
1.3	Three-tier architecture (Lecture 1)	1
1.4	Three-tier architecture (Lecture 2)	1
1.5	Design considerations for mobile computing (Lecture 1)	1
1.6	Design considerations for mobile computing (Lecture 2)	1
Module-2 (Communication Systems) (7hrs)		
2.1	Evolution of telephony, Multiple access procedures – FDMA, TDMA, CDMA, SDMA	1
2.2	Satellite communication systems – GEO, MEO, LEO, Satellite phones	1
2.3	Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application (Call flow diagram)	1
2.4	Introduction to GSM,Architecture	1
2.5	GSM entities, Call routing	1
2.6	Mobility management	1
2.7	Frequency allocation, Authentication and security	1
Module-3 (Short Messaging Service and General Packet Radio Service) (8hrs)		
3.1	SMS Strengths, Architecture, Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages	1
3.2	SMS Architecture - Operator-centric pull, operator-	1

	independent push/pull, Value added services	
3.3	Accessing the SMS bearer (Lecture 1)	1
3.4	Accessing the SMS bearer (Lecture 2)	1
3.5	GPRS architecture	1
3.6	Network operations	1
3.7	Data services, Applications	1
3.8	Limitations, Billing and charging	1
Module-4 (Wireless Local Area Networks) (7 hrs)		
4.1	WLAN Advantages, Evolution, Applications	1
4.2	WLAN Architecture (Lecture 1)	1
4.3	WLAN Architecture (Lecture 2)	1
4.4	Mobility, Security	1
4.5	Deploying WLAN	1
4.6	WLL Architecture, HIPERLAN	1
4.7	WiFi Vs 3G	1
Module-5 (Mobile Security and Next Generation Networks) (7hrs)		
5.1	Information security – Attacks, Components	1
5.2	Security techniques and algorithms – Stream Vs Block cipher, Symmetric Vs Asymmetric cryptography	1
5.3	Security techniques and algorithms – RSA, Diffie Hellman Key exchange	1
5.4	Security protocols – Secure Socket Layer, Transport Layer Security, Wireless Transport Layer Security	1
5.5	The Converged Scenario, Narrowband to broadband	1
5.6	Orthogonal Frequency Division Multiplexing (OFDM) and Multi Protocol Label Switching (MPLS)	1
5.7	Wireless Asynchronous Transfer Mode (WATM) and Multimedia broadcast services	1

CST425	INTRODUCTION TO DEEP LEARNING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: This course aims to introduce the learner to an overview of the concepts and algorithms involved in deep learning. Basic concepts and application areas of machine learning, deep networks, convolutional neural network and recurrent neural network are covered in this course. This is a foundational program that will help students understand the capabilities, challenges, and consequences of deep learning and prepare them to participate in the development of leading-edge AI technology. They will be able to gain the knowledge needed to take a definitive step in the world of AI.

Prerequisite: Basics of linear algebra and probability.

Course Outcomes: After the completion of the course the student will be able to

CO1	Demonstrate basic concepts in machine learning.(**Cognitive Knowledge Level: Understand)**
CO2	Illustrate the validation process of machine learning models using hyper-parameters and validation sets. **(Cognitive Knowledge Level: Understand)**
CO3	Demonstrate the concept of the feed forward neural network and its training process. **(Cognitive Knowledge Level: Apply)**
CO4	Build CNN and Recurrent Neural Network (RNN) models for different use cases. **(Cognitive Knowledge Level: Apply)**
CO5	Use different neural network/deep learning models for practical applications. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓	✓	✓								✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓	✓	✓								✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		End Semester Examination Marks (%)
	Test 1 (%)	**Test 2 (%)**	
Remember	**30**	**30**	**30**
Understand	**30**	**30**	**30**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Syllabus

Module-1 (Introduction)

Key components - Data, models, objective functions, optimization algorithms, Learning algorithms. Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting , hyperparameters and validation sets, estimators, bias and variance.

Module- 2 (Optimization and Neural Networks)

Neural Networks –Perceptron, Gradient Descent solution for Perceptron, Multilayer perceptron, activation functions, architecture design, chain rule, back propagation, gradient based learning. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges.

Module -3 (Convolutional Neural Network)

Convolutional Neural Networks – convolution operation, motivation, pooling, Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms.

Module- 4 (Recurrent Neural Network)

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks, modern RNNs LSTM and GRU, Practical use cases for RNNs.

Module-5 (Application Areas)

Applications – computer vision, speech recognition, natural language processing. Research Areas – Autoencoders, Representation learning, Boltzmann Machines, Deep belief networks.

Text Book

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press 2015 ed.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, August 2019.
3. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal. Springer.1st edition, 2018.

Reference Books

1. Neural Smithing: Supervised Learning in Feed forward Artificial Neural Networks by Russell Reed, Robert J MarksII, 1st edition, 1999, MIT Press.
2. Practical Convolutional Neural Networks by Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari, 1st edition, 2018, Packt Publishing Ltd.
3. Hands-On Deep Learning Algorithms with Python by Sudharsan Ravichandran, 1st edition, 2019, Packt Publishing Ltd.
4. Deep Learning with Python by Francois Chollet, 2nd edition, 2018, Manning Publications Co.

Sample Course Level Assessment Questions

Course Outcome1(CO1):

1. Compare regression and classification.
2. Define supervised learning? Distinguish between regression and classification.
3. Discuss the different learning approaches used in machine learning.
4. You train an initial model that achieves a 90% accuracy on the training dataset. What kind of problems your model is experiencing, and suggest a possible solution.
5. How does splitting a dataset into train, validation and test sets help identify overfitting?
6. Consider solving a classification task. You first train your network on 20 samples. Training converges, but the training loss is very high. You then decide to train this network on 10,000 examples. Is your approach to fixing the problem correct? If yes, explain the most likely results of training with 10,000 examples. If not, give a solution to this problem.

7. Describe one advantage of using mini-batch gradient descent instead of full-batch gradient descent.
8. Sketch the typical learning curves for the training and validation sets, for a setting where overfitting occurs at some point. Assume that the training set and the validation set are of the same size

Course Outcome 2(CO2):

1. What are hyperparameters? Why are they needed?
2. What issues are to be considered while selecting a model for applying machine learning in a given problem?
3. Update the parameters V11 in the given MLP using back propagation with learning rate as 0.5 and activation function as sigmoid. Initial weights are given as V11= 0.2, V12=0.1, V21=0.1, V22=0.3, V11=0.2, W11=0.5, W21=0.2
4. Draw the architecture of a multi-layer perceptron.
5. Derive update rules for parameters in the multi-layer neural network through the gradient descent.
6. Why is it important to place non-linearities between the layers of neural networks?
7. You design a fully connected neural network architecture where all activations are sigmoids. You initialize the weights with large positive numbers. Is this a good idea? Explain your answer.
8. You are doing full batch gradient descent using the entire training set (not stochastic gradient descent). Is it necessary to shuffle the training data? Explain your answer.
9. Consider training a fully-connected neural network with 5 hidden layers, each with 10 hidden units. The input is 20-dimensional and the output is a scalar. What is the total number of trainable parameters in your network?
10. Consider building a 10-class neural network classifier. Given a cat image, you want to classify which of the 10 cat breeds it belongs to. What loss function do you use? Introduce the appropriate notation and write down the formula of the loss function.
11. Why is the sigmoid activation function susceptible to the vanishing gradient problem?

Course Outcome 3 (CO3):

1. Give two benefits of using convolutional layers instead of fully connected ones for visual tasks.
2. Suppose that a CNN was trained to classify images into different categories. It performed well on a validation set that was taken from the same source as the training set but not on a testing set. What could be the problem with the training of such a CNN? How will you ascertain the problem? How can those problems be solved?
3. You are given a dataset of 10 x 10 grayscale images. Your goal is to build a 5-class classifier. You have to adopt one of the following two options: a) the input isflattened into a 100-dimensional vector, followed by a fully-connected layer with 5

neurons, b) the input is directly given to a convolutional layer with five 10 x 10 filters. Explain which one you would choose and why.

4. Weight sharing allows CNNs to deal with image data without using too many parameters. Does weight sharing increase the bias or the variance of a model?
5. Why do the layers in a deep architecture need to be non-linear?
6. A convolutional neural network has 4 consecutive layers as follows:
   3 x 3 conv (stride 2) - 2 x 2 Pool - 3 x 3 conv (stride 2) - 2 x 2 Pool
   How large is the set of image pixels which activate a neuron in the 4th non-image layer of this network?
7. Consider a convolution layer. The input consists of 6 feature maps of size 20 x 20. The output consists of 8 feature maps, and the filters are of size 5 x 5. The convolution is done with a stride of 2 and zero padding, so the output feature mapsare of size 10 x 10. Determine the number of weights in this convolution layer

Course Outcome 4(CO4):

1. Explain how the cell state is updated in the LSTM model from Ct-1 to Ct
2. Show the steps involved in an LSTM to predict stock prices.
3. Illustrate the workings of the RNN with an example of a single sequence defined on a vocabulary of four words.
4. If we have a recurrent neural network (RNN), we can view it as a different type of network by "unrolling it through time". Briefly explain what that means.
5. Briefly explain how “unrolling through time” is related to “weight sharing” in convolutional networks.
6. Explain how the cell state is updated in the LSTM model from Ct-1 to Ct
7. Show the steps involved in an LSTM to predict stock prices.Give one advantage of using an RNN rather than a convolutional network.

Course Outcome 5 (CO5):

1. Development a deep learning solution for problems in the domain i) natural language processing or ii Computer vision (Assignment)
2. Is an autoencoder for supervised learning or for unsupervised learning? Explain briefly.
3. Sketch the architecture of an autoencoder network.
4. Describe how to train an autoencoder network.
5. Write down the formula for the energy function (E) of a Restricted Boltzmann Machine (RBM).

Model Question Paper

QP CODE:

Reg No: _____

Name:_____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST425

Course Name: Introduction To Deep Learning

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Distinguish between supervised learning and Reinforcement learning. Illustrate with an example.
2. Differentiate classification and regression.
3. Compare overfitting and underfitting. How it can affect model generalization.
4. Why does a single perceptron cannot simulate simple XOR function? Explain how this limitation is overcome?
5. Illustrate the strengths and weaknesses of convolutional neural networks.
6. Illustrate convolution and pooling operation with an example
7. How many parameters are there in AlexNet? Why the dataset size (1.2 million) is important for the success of AlexNet?
8. Explain your understanding of unfolding a recursive or recurrent computation into a computational graph.
9. Illustrate the use of deep learning concepts in Speech Recognition.
10. What is an autoencoder? Give one application of an autoencoder

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) "A computer program is said to learn from experience E with respect to some class oftasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E." What is your understanding of the terms task, performance and experience. Explain with two example **(10)**

(b) "How does bias and variance trade-off affect machine learning algorithms? **(4)**

OR

12. (a) Illustrate the concepts of Web search, Page Ranking, Recommender systems with suitable examples. **(10)**

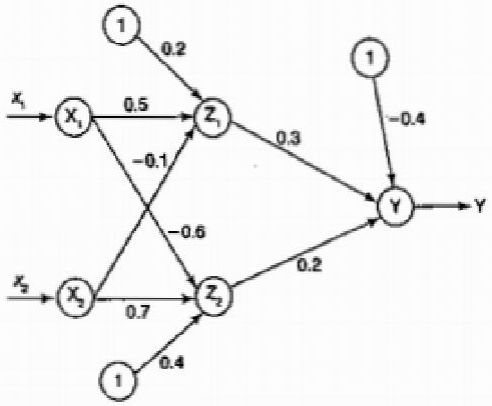
(b) List and discuss the different hyper parameters used in fine tuning the traditional machine learning models **(4)**

13. (a) How multilayer neural networks learn and encode higher level features from input features. **(7)**

(b) Explain gradient decent and delta rule? Why stochastic approximation to gradient descent is needed? **(7)**

OR

14. (a) Find the new weights for the network using backpropogation algorithm, the network is given with a input pattern[-1,1] and target output as +1, Use learning rate of alpha=0.3 and bipolar sigmoid function. **(7)**



(b) Write an algorithm for backpropagation which uses stochastic gradient descent method. Comment on the effect of adding momentum to the network. **(7)**

15. (a) Input to CNN architecture is a color image of size 112x112x3. The first convolution layer comprises of 64 kernels of size 5x5 applied with a stride of 2 and padding 0. What will be the number of parameters? **(5)**

(b) Let X=[-1, 0, 3, 5] W=[.3 ,.5 .2,.1] be the the input of i^{th} layer of a neural network and to apply softmax function. What should be the output of it? **(4)**

(c) Draw and explain the architecture of convolutional network **(5)**

OR

16. (a) Explain the concept behind i) Early stopping ii) dropout iii) weight decay **(9)**

(b) How backpropagation is used to learn higher-order features in a convolutional Network? **(5)**

17. (a) Explain the working of RNN and discuss how backpropagation through time is used in recurrent networks. **(8)**

(b) Describe the working of a long short term memory in RNNs. **(6)**

OR

18. (a) What is the vanishing gradient problem and exploding gradient problem? **(8)**

(b) Why do RNNs have a tendency to suffer from exploding/vanishing gradient? How to overcome this challenge? **(6)**

19. (a) Explain any two word embedding techniques **(8)**

(b) Explain the merits and demerits of using Auto encoders in Computer Vision. **(6)**

OR

20. (a) Illustrate the use of representation learning in object classification. **(7)**

(b) Compare Boltzmann Machine with Deep Belief Network. **(7)**

Teaching Plan

No	Contents	No. of Lecture Hours (37 hrs)
Module 1 : Introduction (8 hours)		
1.1	Key components - Data, models, objective functions, optimization algorithms. (TB2: Section 1.1-1.2)	1
1.2	Learning algorithm (TB1: Section 5.1), Supervised learning- regression, classification, tagging, web search, page ranking (TB2: Section 1.3.1)	1
1.3	Recommender systems, Sequence learning, Unsupervised learning, Reinforcement learning(TB2: Section 1.3.2-1.3.4)	1
1.4	Historical Trends in Deep Learning (TB1: Section 1.2).	1
1.5	Concepts: overfit, underfit, hyperparameters and validation sets. (TB1: Section 5.2-5.3)	1
1.6	Concepts: Estimators, bias and variance. (TB1: Section 5.4)	1
1.7	Demonstrate the concepts of supervised learning algorithms using a suitable platform.	1
1.8	Demonstrate the concepts of unsupervised using a suitable platform.	1
Module 2 : Optimization and Neural Networks (9 hours)		
2.1	Perceptron, Stochastic Gradient descent, Gradient descent solution for perceptron (TB3: Section 1.1 - 1.2.1)	1
2.2	Multilayer perceptron (TB3: Section 1.2.2), (TB1: Section 6.1,6.3)	1
2.3	Activation functions- Sigmoid, tanh, Softmax, ReLU, leaky ReLU (TB3: Section 1.2.1.3 - 1.2.1.5)	1
2.4	Architecture design (TB1: Section 6.4, TB3: Section 1.6)	1
2.5	Chain rule, back propagation (TB3: Section 1.3)	1
2.6	Gradient based learning (TB1: Section 6.2)	1
2.7	Gradient based optimization (TB1: Section 4.3)	1
2.8	Linear least squares using a suitable platform. (TB1: Section 4.5)	1
2.9	Building ML Algorithms and Challenges (TB3: 1.4, TB1: 5.10-5.11)	1
Module 3 :Convolution Neural Network (8 hours)		
3.1	Convolution operation (TB1:Section 9.1)	1
3.2	Motivation, pooling (TB1:Section 9.2-9.3)	1

3.3	Convolution and Pooling as an infinitely strong prior (TB1: Section 9.4)	1
3.4	Variants of convolution functions – multilayer convolutional network, tensors, kernel flipping, downsampling, strides and zero padding. (TB1: Section 9.5)	1
3.5	Variants of convolution functions - unshared convolutions, tiled convolution, training different networks. (TB1: Section 9.5)	1
3.6	Structured outputs, data types (TB1: Section 9.6-9.7)	1
3.7	Efficient convolution algorithms. (TB1: Section 9.8,9.10)	1
3.8	Case Study: AlexNet, VGG, ResNet. (TB3: Section 8.4.1, 8.4.3, 8.4.5)	1
Module 4 :Recurrent Neural Network (7 hours)		
4.1	Computational graphs (TB1: Section 10.1)	1
4.2	RNN (TB1: Section 10.2-10.3)	1
4.3	Encoder – decoder sequence to sequence architectures. (TB1: Section 10.4)	1
4.4	Deep recurrent networks (TB1: Section 10.5)	1
4.5	Recursive neural networks , Modern RNNs, LSTM and GRU (TB1: Section 10.6, 10.10)	1
4.6	Practical use cases for RNNs. (TB1: Section 11.1-11.4)	1
4.7	Demonstrate the concepts of RNN using a suitable platform.	1
Module 5 : Applications and Research (5 hours)		
5.1	Computer vision. (TB1: Section 12.2)	1
5.2	Speech recognition. (TB1: Section 12.3)	1
5.3	Natural language processing. (TB1: Section 12.4)	1
5.4	Brief introduction on current research areas- Autoencoders, Representation learning. (TB1: Section 14.1-14.2, TB3: 9.3)	1
5.5	Brief introduction on current research areas- Boltzmann Machines, Deep belief networks. (TB1: Section 20.1, 20.3)	1

CST435	COMPUTER GRAPHICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develop algorithms for emerging display technologies.

Prerequisite: A sound knowledge of Mathematics and concepts of any programming language.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Describe the working principles of graphics devices**(Cognitive Knowledge level: Understand)**
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms**(Cognitive Knowledge level: Apply)**
CO3	Demonstrate geometric representations and transformations on 2D & 3D objects **(Cognitive Knowledge level: Apply)**
CO4	Demonstrate the working of line and polygon clipping algorithms**(Cognitive Knowledge level: Apply)**
CO5	Summarize visible surface detection methods and illustrate projection algorithms. (**Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓										✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of SeriesTests1&2) **25 marks**

Continuous AssessmentAssignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one fullquestion. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1(Basics of Computer graphics)

Basics of Computer Graphics and its applications. Video Display devices- Refresh Cathode Ray Tubes(CRT), Random Scan Displays and systems, Raster scan displays and systems, Color CRT displays, Flat panel display and its categories.

Module – 2 (Line drawing, Circle drawing and Filled Area Primitives)

Line drawing algorithms- DDA, Bresenham's algorithm. Circle drawing algorithms- Midpoint Circle generation algorithm, Bresenham's algorithm. Filled Area Primitives- Scan line polygon filling, Boundary filling and flood filling.

Module - 3 (Geometric transformations)

Two dimensional transformations-Translation, Rotation, Scaling, Reflection and Shearing, Composite transformations, Matrix representations and homogeneous coordinates. Basic 3D transformations.

Module - 4 (Clipping)

Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms.

Module - 5 (Three dimensional graphics)

Three dimensional viewing pipeline. Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm

Text Book

1. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996

References

1. William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
2. David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill,2001.
3. Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with OpenGL, PHI, 4e, 2013

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Compare the working principle of raster scan systems and random scan systems.
2. How much time is spent scanning across each row of pixels during screen refresh on a raster system with resolution of 1280*1024 and a refresh rate of 60 frames per second?

Course Outcome 2 (CO2):

1. Rasterize the line using Bresenham's line drawing algorithm with end points (2,3) and (5,8) accepted from the user and implement it using any appropriate programming language. (Assignment)
2. Illustrate how the 4-connected boundary filling approach differs from 8-connected boundary filling and implement it using any appropriate programming language. (Assignment)

Course Outcome 3 (CO3):

1. Rotate a triangle ABC 45 degree counter clockwise about the pivot point (10,3) , where the position vector of the coordinates is given as A(4,1), B(5,2) and C(4,3).
2. Implement the above transformation using any appropriate programming language with user inputs. (Assignment)
3. Illustrate the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation.

Course Outcome 4 (CO4):

1. Given a clipping window A(20,20), B(60,20), C(60,40) and D(20,40). Using Cohen Sutherland algorithm, find the visible portion of the line segment joining the pointsP(40,80) and Q(120,30).

2. Implement Cohen Sutherland clipping algorithm using any appropriate programming language with user inputs. (Assignment)

Course Outcome 5 (CO5):

1. Explain scan line algorithm for detecting visible surfaces in an object.
2. Derive the matrix for performing perspective projection and parallel projection.

Model Question Paper

QP CODE:

Reg No: _____

Name:_____ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST435

Course Name: Computer Graphics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Describe Flat Panel display and its categories.
2. Consider a raster system with a resolution of 1024*1024. Compute the size of the raster needed to store 4 bits per pixel? How much storage is needed if 8 bits per pixel are to be stored?
3. Justify the usage of integer arithmetic in Bresenham's line drawing algorithm.
4. How 8-way symmetry of circle can be used for developing circle drawing algorithms?
5. Show that two successive reflections about either of the coordinate axes is equivalent to a single rotation about the coordinate origin.
6. Determine a sequence of basic transformations that is equivalent to x-direction shearing.
7. Find the window to viewport normalization transformation with window lower left corner at (1,1) and upper right corner at (2,6).

8. How does Cohen Sutherland algorithm determine whether a line is visible, invisible or a candidate for clipping based on the region codes assigned to the end points of the line?

9. Define the terms (i) Centre of projection (ii) Principal vanishing point

10. Differentiate between the object space and image space method for the hidden surface removal of an image. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Explain the working principle of beam penetration method and shadow mask method with suitable illustrations. **(8)**

(b) Draw the architecture of raster scan display systems and explain its working principle. **(6)**

OR

12. (a) Explain the working principle of a Refresh CRT monitor with suitable diagrams. **(8)**

(b) Describe random graphics system with suitable illustrations. **(6)**

13. (a) Differentiate between boundary fill and flood fill algorithms. **(5)**

(b) Derive the initial decision parameter of Bresenham's line drawing algorithm and rasterize a line with endpoints (2,2) and (10,10). **(9)**

OR

14. (a) Write Midpoint circle drawing algorithm and identify the points in the circle with radius as 20 and center at (50,30) using the algorithm. **(8)**

(b) Illustrate the working principle of scan line polygon filling algorithm. **(6)**

15. (a) Reflect a triangle ABC about the line 3x-4y+8=0, where the coordinates of the triangle are given as A(4,1), B(5,2) and C(4,3). **(8)**

(b) A diamond shaped polygon is located at P(-1,0), Q(0,-2), R(1,0) and S(0,2). Find the transformation matrix which would rotate the triangle by 90 degree counter clockwise about the point Q. Using the transformation matrix, find the coordinates of the rotated polygon. **(6)**

OR

16. (a) Describe the steps required for a general 3D rotation if the rotation axis is not parallel to any one of the principal axis. The rotation axis is defined by the points P1(x1,y1,z1) and P2(x2,y2,z2). Give its composite matrix representation. **(8)**

(b) Consider a triangle at (2,2), (10,2), (2,10). Perform the following 2D transformations in succession and find the resultant vertices. **(6)**

i) Scale with respect to (2,2) by scaling factors (2,2) along x and y directions.

ii) Rotate by 90 degree counter clockwise direction.

iii) Reflection based on y=x

17. (a) Illustrate Weiler – Atherton polygon clipping algorithm. **(6)**

(b) Explain Cohen-Sutherland line clipping algorithm. Use the algorithm to clip line with end points P1 (70, 20) and P2(100,10) against a window with lower left hand corner (50,10) and upper right hand corner (80,40). **(8)**

OR

18. (a) Describe Sutherland Hodgeman polygon clipping algorithm and list out its limitations. **(7)**

(b) Explain the steps involved in clipping a line using Mid point Subdivision algorithm. **(7)**

19. (a) Explain how visible surfaces can be detected using depth buffer algorithm. **(7)**

(b) Define parallel projection. Describe orthographic and oblique parallel projection. **(7)**

OR

20. (a) Illustrate the scan line method used in visible surface detection. **(7)**

(b) Derive the matrix needed for performing perspective projections. **(7)**

TEACHING PLAN

No	Contents	No of Lecture Hrs (35 hrs)
Module – 1 (Basics of Computer Graphics) (6 hrs)		
1.1	Basics of Computer Graphics and applications	1
1.2	Refresh Cathode Ray Tubes	1
1.3	Random Scan Displays and systems	1
1.4	Raster scan displays and systems	1
1.5	Color CRT displays	1
1.6	Flat panel display and its categories.	1
Module - 2 (Line drawing, Circle drawing and Filled Area Primitives) (7 hrs)		
2.1	DDA Line drawing Algorithm	1
2.2	Bresenham's line drawing algorithm	1
2.3	Midpoint Circle generation algorithm	1
2.4	Bresenham's Circle generation algorithm	1
2.5	Illustration of line drawing and circle drawing algorithms	1
2.6	Scan line polygon filling	1
2.7	Boundary filling and flood filling	1
Module - 3 (Geometric transformations) (8 hrs)		
3.1	Basic 2D transformations-Translation and Rotation	1
3.2	Basic 2D transformations- Scaling	1
3.3	Reflection and Shearing	1
3.4	Illustration of 2D Transformations	1
3.5	Composite transformations	1
3.6	Matrix representations and homogeneous coordinates	1
3.7	Basic 3D transformations	1
3.8	Illustration of basic 3D transformations	1
Module - 4 (2D Clipping) (6 hrs)		
4.1	Window to viewport transformation	1
4.2	Cohen Sutherland Line clipping algorithm	1
4.3	Midpoint subdivision Line clipping algorithm	1
4.4	Sutherland Hodgeman Polygon clipping algorithm	1
4.5	Weiler Atherton Polygon clipping algorithm	1
4.6	Practice problems on Clipping algorithms	1
Module - 5 (Three dimensional graphics)(8 hrs)		
5.1	Three dimensional viewing pipeline, Projections-Parallel projections	1

5.2	Projections- Perspective projections	1
5.3	Visible surface detection algorithms- Back face detection.	1
5.4	Depth buffer algorithm	1
5.5	Depth buffer algorithm	1
5.6	Scan line visible surface detection algorithm	1
5.7	Scan line visible surface detection algorithm	1
5.8	A buffer algorithm	1

CST445	PYTHON FOR ENGINEERS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The objective of the course is to provide learners an insight into Python programming in a scientific computation context and develop programming skills to solve engineering problems. It covers programming environment, important instructions, data representations, intermediate level features, Object Oriented Programming and file data processing of Python. This course lays the foundation to scientific computing, develop web applications, Machine Learning, and Artificial Intelligence-based applications and tools, Data Science and Data Visualization applications.

Prerequisite: NIL

Note : *Students who have successfully completed CST 283 - Python for Machine Learning (Minor) are not eligible to opt this course.*

Course Outcomes: After the completion of the course the student will be able to

CO1	Write, test and debug Python programs **(Cognitive Knowledge level: Apply)**
CO2	Illustrate uses of conditional (if, if-else, if-elif-else and switch-case) and iterative (while and for) statements in Python programs **(Cognitive Knowledge level: Apply)**
CO3	Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python **(Cognitive Knowledge level: Apply)**
CO4	Implement Object Oriented programs with exception handling **(Cognitive Knowledge level: Apply)**
CO5	Analyze, Interpret, and Visualize data according to the target application (**Cognitive Knowledge level: Apply**)
CO6	Develop programs in Python to process data stored in files by utilizing the modules Numpy, Matplotlib, and Pandas **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓										✓
CO3	✓	✓										✓
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓							✓
CO6	✓	✓	✓		✓							✓

Abstract POs defined by National Board of Accreditation

#PO	Broad PO	#PO	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (*Marks in percentage*)	Test 2 (*Marks in percentage*)	End Semester Examination Marks
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test	: 25 marks
Continuous Assessment Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. The first series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing the remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have a maximum of 2 sub-divisions and carries 14 marks.

Syllabus

Module 1 (Basics of Python)

Getting Started with Python Programming - Running code in the interactive shell, Editing, Saving, and Running a script. Using editors - IDLE, Jupyter. Basic coding skills - Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions, Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output, Formatting output. How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module. Control statements - Selection structure - if-else, if-elif-else. Iteration structure - for, while. Testing the control statements. Lazy evaluation.

Module 2 (Functions and Python Data Structures)

Functions - Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions. Strings - String function. Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension. Work with tuples. Sets. Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries, reverse lookup.

Module 3 (Object Oriented Programming)

Design with classes - Objects and Classes, Methods, Instance Variables, Constructor, Accessors and Mutators. Structuring classes with Inheritance and Polymorphism. Abstract Classes. Exceptions - Handle a single exception, Handle multiple exceptions.

Module 4 (Visualization and File handling)

Plotting - An Interactive Session with PyPlot, Basic Plotting, Logarithmic Plots, More Advanced Graphical Output, Plots with multiple axes, Mathematics and Greek symbols, The Structure of matplotlib, Contour and Vector Field Plots. File Processing - The os and sys modules, Introduction to file I/O, Reading and writing text files, Working with CSV files.

Module 5 (Scientific Computing)

Numerical Routines. SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Special Functions, Random Numbers, Linear Algebra, Solving Nonlinear Equations, Numerical Integration, Solving ODEs. Data Manipulation and Analysis – Pandas : Reading Data from Files Using Pandas, Data Structures: Series and DataFrame, Extracting Information from a DataFrame, Grouping and Aggregation.

Text Books:

1. Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016
2. David J. Pine, Introduction to Python for Science and Engineering, CRC Press, 2021

Reference Books:

1. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
3. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
4. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.
5. Charles Severance. Python for Informatics: Exploring Information,
6. http://swcarpentry.github.io/python-novice-gapminder/

Sample Course Level Assessment Questions

Course Outcome1(CO1):

1. What is type conversion? How is it done in Python?

Course Outcome 2(CO2):

1. Given is a list of of words, *wordlist*, and a string, *name*. Write a Python function which takes *wordlist* and *name* as input and returns a tuple. The first element of the output tuple is the number of words in the *wordlist* which have *name* as a substring in it. The second element of the tuple is a list showing the index at which the *name* occurs in each of the words of the *wordlist* and a 0 if it doesn't occur.

Course Outcome 3(CO3):

1. Write a Python program to implement the addition, subtraction, and multiplication of complex numbers using classes. Use constructors to create objects. The input to the program consist of real and imaginary parts of the complex numbers.

Course Outcome 4(CO4):

1. Plot the function $y = 3x^2$ for $-1 \leq x \leq 3$ as a continuous line. Include enough points so that the curve you plot appears smooth. Label the axes x and y

Course Outcome 5(CO5):

1. Given a file "auto.csv" of automobile data with the fields *index, company, body-style, wheel-base, length, engine-type, num-of-cylinders, horsepower, average-mileage,* and *price***,** write python code to
   i. Clean and Update the CSV file
   ii. Print total cars of all companies
   iii. Find the average mileage of all companies
   iv. Find the highest priced car of all companies.

Model Question Paper

QP CODE: PAGES:

Reg No:_____
Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: CST445

Course name : PYTHON FOR ENGINEERS

Max Marks: 100 **Duration: 3 Hours**

PART-A

(Answer All Questions. Each question carries 3 marks)

1. Explain the basic data types available in Python, with examples.
2. Write a Python program to reverse a number and also find the sum of digits of the number. Prompt the user for input.
3. Compare tuples, lists, and dictionaries.
4. Explain the concept of scope and lifetime of variables in Python programming language, with a suitable example.
5. What is polymorphism? Give an example in the context of OOP in Python.
6. How is exception handling accomplished in Python programs?
7. Describe the characteristics of the CSV format.

8. Plot the function $y = 3x^2$ for $-1 \leq x \leq 3$ as a continuous line. Include enough points so that the curve you plot appears smooth. Label the axes x and y

9. Describe random number generation using Python

10. How can a generalized eigen value problem can be solved using Python?

PART-B

(Answer any one full question from each module)

Module -1

11. (a) Compare and contrast interpreted languages and compiled languages. How does it affect the quality of program development and execution ofthe program? (6)

(b) What are the possible errors in a Python program. Write a Python program to print the value of $2^{2n}+n+5$ for n provided by the user. (8)

OR

12. (a) Describe Arithmetic operators, Assignment operators, Comparison operators, Logical operators, and Bitwise operators in detail with examples. (6)

(b) Input 4 integers (+ve and −ve). Write a Python code to find the sum of negative numbers, positive numbers, and print them. Also, find the averages of these two groups of numbers and print (8)

Module -2

13. (a) Write a Python code to create a function called *list_of_frequency* that takes a string and prints the letters in non-increasing order of the frequency of their occurrences. Use dictionaries. (5)

(b) Write a Python program to read a list of numbers and sort the list in a non-decreasing order without using any built in functions. Separate function should be written to sort the list wherein the name of the list is passed as the parameter. (9)

OR

14. (a) Illustrate the following Set methods with an example. (8)

i. *intersection( )* ii. *Union( )* iii. *Issubset( )* iv. *Difference( )* v. *update( )* vi. *discard( )*

(b) Write a Python program to check the validity of a password given by the user. (6)

The Password should satisfy the following criteria:

1. Contains at least one letter between a and z
2. Contains at least one number between 0 and 9
3. Contains at least one letter between A and Z

4. Contains at least one special character from $, #, @

5. Minimum length of password: 6

Module -3

15. (a) How can a class be instantiated in Python? Write a Python program to express the instances as return values to define a class RECTANGLE with parameters *height, width, corner_x,* and *corner_y* and member functions to find center, area, and perimeter of an instance. (5)

(b) Explain inheritance in Python. Give examples for each type of inheritance. (9)

OR

16. (a) Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a given circle (6)

(b) Define a class in Python to store the details of a ship (name, source,destination) with the following methods: (8)

i) *get_details( )* - to assign values to class attributes

ii) *print_details( )* - to display the attribute values

Create an object of the class and invoke the methods

Module -4

17. (a) Plot the functions *sin x* and *cos x* vs *x* on the same plot with x going from $-\pi$ to π. Make sure the limits of the *x*-axis do not extend beyond the limits of the data. Plot *sin x* in the color orange and *cos x* in the color green and include a legend to label the two curves. Place the legend within the plot,but such that it does not cover either of the sine or cosine traces. Draw thin gray lines behind the curves, one horizontal at $y = 0$ and the other vertical at $x = 0$. (10)

(b) Explain semi-log plots and log-log plots along with the functions used in creating such plots. (4)

OR

18. (a) Explain how *matplotlib* can be used to create dimensional contour plots and vector field plots. (6)

(b) Given a file "*auto.csv*" of automobile data with the fields *index, company, body-style, wheel-base, length, engine-type, num-of-cylinders, horsepower, average-mileage,* and *price,* write Python codes using Pandas to (8)

1) Clean and Update the CSV file
2) Print total cars of all companies
3) Find the average mileage of all companies
4) Find the highest priced car of all companies.

Module -5

19. (a) Write python program to solve the following system of equations (4)

$x_1 - 2x_2 + 9x_3 + 13x_4 = 1$

$-5x_1 + x_2 + 6x_3 - 7x_4 = -3$

$4x_1 + 8x_2 - 4x_3 - 2x_4 = -2$

$8x_1 + 5x_2 - 7x_3 + x_4 = 5$

(b) Given the sales information of a company as CSV file with the following fields *month_number, facecream, facewash, toothpaste, bathingsoap, shampoo, moisturizer, total_units, total_profit*. Write Python codes to visualize the data as follows (10)

1) Toothpaste sales data of each month and show it using a scatter plot
2) Face cream and face wash product sales data and show it using the bar chart

Calculate total sale data for last year for each product and show it using a Pie chart.

OR

20. (a) Write Python program to write the data given below to a CSV file. (9)

SN	Name	Country	Contribution	Year
1	Linus Torvalds	Finland	Linux Kernel	1991
2	Tim Berners-Lee	England	World Wide Web	1990
3	Guido van Rossum	Netherlands	Python	1991

(b) Explain how integration is performed with SciPy. Illustrate the same with the two sample integrals using SciPy function. (5)

Teaching Plan

Sl No	Contents	Number of Hours (35 Hrs)
Module 1: Basics of Python (8 hours)		
1.1	Getting Started with Python Programming: Running code in the interactive shell Editing, Saving, and Running a script	1 hour
1.2	Using editors: IDLE, Jupyter	1 hour
1.3	Basic coding skills: Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions,	1 hour
1.4	Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output. Formatting output	1 hour
1.5	How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module.	1 hour
1.6	Control statements : Selection structure, if-else, if ~~elif~~else	1 hour
1.7	Iteration structure - for, while	1 hour
1.8	Testing the control statements, Lazy evaluation.	1 hour
Module 2: Functions and Python Data Structures (8 hours)		
2.1	Functions: Hiding redundancy and complexity, Arguments and return values	1 hour
2.2	Variable scopes and parameter passing	1 hour
2.3	Named arguments, Main function,	1 hour
2.4	Working with recursion, Lambda functions	1 hour
2.5	Strings - String function	1 hour
2.6	Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension.	1 hour
2.7	Work with tuples. Sets.	1 hour
2.8	Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, Accessing and replacing values, traversing dictionaries, reverse lookup	1 hour
Module 3: Object Oriented Programming (6 hours)		
3.1	Design with classes : Objects and Classes, Methods, Instance Variables	1 hour
3.2	Constructor, Accessors, and Mutators	1 hour
3.3	Structuring classes with Inheritance	1 hour
3.4	Polymorphism	1 hour
3.5	Abstract Classes	1 hour
3.6	Exceptions: Handle a single exception, Handle multiple exception	1 hour
Module 4: Visualization and File handling (6 hours)		

4.1	Plotting - An Interactive Session with PyPlot, Basic Plotting,	1 hour
4.2	Logarithmic Plots, More Advanced Graphical Output	1 hour
4.3	Plots with multiple axes, Mathematics and Greek symbols	1 hour
4.4	The Structure of matplotlib, Contour and Vector Field Plots	1 hour
4.5	File Processing -The *os* and *sys* modules, Introduction to file I/O, Reading and writing text files	1 hour
4.6	Working with CSV files	1 hour
Module 5: Scientific Computing (7 hours)		
5.1	Numerical Routines: SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing	1 hour
5.2	Matrix Operations, Special Functions, Random Numbers	1 hour
5.3	Linear Algebra, Solving Nonlinear Equations	1 hour
5.4	Numerical Integration, Solving ODEs	1 hour
5.5	Data Manipulation and Analysis: Pandas - Reading Data from Files Using Pandas	1 hour
5.6	Data Structures - Series and DataFrame	1 hour
5.7	Extracting Information from a DataFrame, Grouping and Aggregation	1 hour

CST455	OBJECT ORIENTED CONCEPTS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		OEC	2	1	0	3	2019

Preamble: The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course provides learners the basics to develop Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

Prerequisite: A sound background in any of the programming languages like C, C++, Python etc is mandatory. Students who completed the minor stream course CST 281 Object Oriented Programming are not allowed to choose this Open Elective Course.

Course Outcomes: After the completion of the course the student will be able to

CO1	Develop Java programs using the object-oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism **(Cognitive Knowledge Level: Apply)**
CO2	Utilise data types, operators, control statements, built in packages & interfaces, Input/Output Streams and Files in Java to develop programs **(Cognitive Knowledge Level: Apply)**
CO3	Illustrate how robust programs can be written in Java using exception handling mechanism **(Cognitive Knowledge Level: Apply)**
CO4	Develop application programs in Java using multithreading **(Cognitive Knowledge Level: Apply)**
CO5	Develop Graphical User Interface based application programs by utilising event handling features and Swing in Java **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2
CO1	✓	✓	✓									✓
CO2	✓	✓	✓									✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	**20**	**20**	**20**
Understand	**40**	**40**	**40**
Apply	**40**	**40**	**40**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3**

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous AssessmentAssignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question

from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Object Orientation and Java basics)

Object Orientation Principles – Object and Class, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of using Object orientation.

Introduction to Java - Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. Java Virtual Machine (JVM), Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues.

Primitive Data types - Integers, Floating Point Types, Characters, Boolean. Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class.

Module – 2 (Core Java Fundamentals)

Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.

Control Statements - Selection Statements, Iteration Statements and Jump Statements.

Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, ***this*** Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, Static Members, Command-Line Arguments, Variable Length Arguments.

Module - 3 (More features of Java)

Inheritance - Super Class, Sub Class, The Keyword ***super***, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, Using ***final*** with Inheritance.

Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces.

Exception Handling - Checked Exceptions, Unchecked Exceptions, ***try*** Block and ***catch*** Clause, Multiple ***catch*** Clauses, Nested ***try*** Statements, ***throw***, ***throws*** and ***finally***.

Module - 4 (Advanced features of Java)

Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Reading and Writing Files.

Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf(), Comparison of String Buffer and String.

Module - 5 (GUI Programming, Event Handling and Multithreaded Programming)

Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Suspending, Resuming and Stopping Threads.

Event Handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model.

Swing Fundamentals - Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Exploring Swing - JFrame, JLabel, JButton, JTextField.

Text Books

1. Herbert Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

Reference Books

1. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11/e, Pearson, 2018.
2. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
3. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
4. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Three types of employees work in an organization: Regular, Contract and Hourly. Regular employees are permanent workers of the organization. Their salary is computed as the sum of basic pay, DA (50% of basic pay) and HRA. Contract employees work for the organization only for the contract period and earn a fixed salary. Hourly employees work for a fixed number of hours each day. Their salary is computed based on the total number of hours worked.

   Using object oriented principles, write a Java program to prepare pay roll of the organization.

2. Write a java program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Square, Triangle and Circle with proper class hierarchy. Each one of the classes contain only the method printArea( ) that prints the area of the given shape.

Course Outcome 2(CO2):

1. Write a Java program that reads a file and displays the file on the screen, with a line number before each line.
2. Write a Java program to prepare the rank list of computer science students based on their performance in the first Semester B.Tech. Degree examination at APJ Abdul Kalam Technological University. The output should be stored in a file.

Course Outcome 3(CO3):

1. Write a program to demonstrate the use of *throws* clause to handle an exception occurred within a method.
2. Write a program to demonstrate how exception handling is supported in Java.

Course Outcome 4(CO4):

1. Write a program to compute the sum of elements in an array using two threads in a parallel way. The first thread sums up the first half of the array and the second thread sums up the second half of the array. Finally, the main thread adds these partial sums and prints the result.
2. Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and ifthe value is even, secondthread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.

Course Outcome 5(CO5):

1. Write a GUI based program to convert temperature from degree Celsius to Fahrenheit.
2. Write a java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with buttons. On selecting a button, an appropriate message with "stop" or "ready" or "go" should appear above the buttons in a selected color. Initially there is no message shown.

Model Question Paper

QP CODE:

Reg No: _____

Name:_____ **PAGES :4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST455

Course Name: Object Oriented Concepts

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Java is considered to be secure and portable. Justify this statement.
2. Describe the concept of dynamic binding.
3. Explain the different arithmetic operators in Java.
4. What does the following Java function compute? Justify your answer.

```
intgreater(int a, int b)
{
while(a!=b)
{
```

```
    if(a>b)
a=a-b;
    else
b=b-a;
}
return a;
}
```

5. Explain the use of CLASSPATH with an example.

6. What are the different types of exceptions?

7. Explain file handling features available in Java.

8. Write a simple program to read an integer value from console and print it.

9. Explain the concept of *main thread* in multi-threading.

10. Explain any two Event classes in Java. **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe in detail polymorphism, abstraction and inheritance with suitable examples. **(9)**

    (b) What is Java Virtual Machine? **(5)**

OR

12. (a) Explain the salient features of Java language. How does Java Enterprise Edition (J2EE) differ from Java Standard Edition (Java SE)? **(9)**

    (b) Explain the declaration and use of multi-dimensional array variables in Java, with example. **(5)**

13. (a) Explain iteration control statements in Java. Give examples. **(8)**

(b) Write a recursive program to compute the factorial of a number. **(6)**

OR

14. (a) Using a suitable Java program, explain the concept of methods and constructors. **(6)**

(b) Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that number. **(8)**

15. (a) In a table format, show the effect of access specifiers within and outside packages in Java. **(6)**

(b) Describe exception handling using **try** block and **catch** clause in Java with the help of a suitable Java program. **(8)**

OR

16. (a) What is an interface in Java? Explain with a suitable example. **(6)**

(b) Write a program that perform integer divisions. The user enters two input data (any data type) through console into variables Num1 and Num2. If Num1 or Num2 were not an integer, the program would throw a Number Format Exception. If Num2 were Zero, the program would throw an Arithmetic Exception. Display the appropriate exception or result. **(8)**

17. (a) Write a Java program that displays the number of characters, lines and words in a text file. **(8)**

(b) Explain any three String constructors with the help of sample code for each. **(6)**

OR

18. (a) Write a program to demonstrate the usage of the *PrintWriter* class. **(7)**

(b) Write a Java program for sorting a given list of names in ascending order. **(7)**

19. (a) Explain Delegation Event model for event handling in Java. **(7)**

(b) Write a program to compute the sum of elements in an array using two **(7)**

threads in a parallel way. The first thread sums up the first half of the array and the second thread sums up the second half of the array. Finally, the main thread adds these partial sums and prints the result.Use Runnable interfacefor the creation of a thread.

OR

20. (a) What are the differences between a process and a thread? **(4)**

(b) Write a Graphical User Interface (GUI) based Java program to implement a simple calculator supporting the operations addition, subtraction, multiplication and division. Use Swing controls to implement GUI. There may be three text boxes, the first two for accepting the operands and the last for displaying the result. Add four buttons for the above operations. Write neat comments in your program to show how you handle events. **(10)**

Teaching Plan

No	Contents	No. of Lecture Hours (36hrs)
	Module – 1 (Object Orientation and Java basics) (7 hrs)	
1.1	Object Orientation Principles – Object and Class, Data abstraction and Encapsulation	1 hour
1.2	Inheritance, Polymorphism	1 hour
1.3	Dynamic binding, Message communication, Benefits of using Object orientation.	1 hour
1.4	Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode	1 hour
1.5	Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues	1 hour
1.6	Primitive Data types - Integers, Floating Point Types, Characters, Boolean	1 hour
1.7	Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector	1 hour

	class.	
Module - 2 (Core Java Fundamentals) (7 hrs)		
2.1	Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence.	1 hour
2.2	Control Statements - Selection Statements, Iteration Statements and Jump Statements.	1 hour
2.3	Object Oriented Programming in Java - Class Fundamentals, Declaring Objects	1 hour
2.4	Object Reference, Introduction to Methods, Constructors, ***this*** Keyword	1 hour
2.5	Method Overloading, Using Objects as Parameters, Returning Objects	1 hour
2.6	Recursion, Access Control, static Members	1 hour
2.7	Command-Line Arguments, Variable Length Arguments	1 hour
Module - 3 (More features of Java) (8 hrs)		
3.1	Inheritance - Super class, Sub class, the keyword super, protected Members	1 hour
3.2	Calling Order of Constructors, Method Overriding, the Object class	1 hour
3.3	Abstract Classes and Methods, Using final with Inheritance	1 hour
3.4	Packages and Interfaces - Defining Package, CLASSPATH, Access Protection	1 hour
3.5	Importing Packages, Interfaces	1 hour
3.6	Exception Handling - Checked Exceptions, Unchecked Exceptions, ***try*** Block and ***catch*** Clause	1 hour
3.7	Multiple ***catch*** Clauses, Nested ***try*** Statements	1 hour
3.8	***throw***, ***throws*** and ***finally***	1 hour
Module - 4 (Advanced features of Java) (6 hrs)		
4.1	Input/Output - I/O Basics, Reading Console Input	1 hour
4.2	Writing Console Output, PrintWriter Class	1 hour
4.3	Working with Files (Lecture-1)	1 hour

4.4	Working with Files (Lecture-2)	1 hour
4.5	Java Library - String Handling – String Constructors, String Length	1 hour
4.6	Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf( ), Comparison of StringBuffer and String.	1 hour
Module - 5 (GUI Programming, Event Handling and Multithreaded Programming) (8hrs)		
5.1	Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread	1 hour
5.2	Creating Multiple Threads	1 hour
5.3	Suspending, Resuming and Stopping Threads.	1 hour
5.4	Event handling - Event Handling Mechanisms, Delegation Event Model	1 hour
5.5	Event Classes,Sources of Events, Event Listener Interfaces	1 hour
5.6	Using the Delegation Model, Swing fundamentals, Swing Key Features	1 hour
5.7	Model View Controller (MVC), Swing Controls, Components and Containers	1 hour
5.8	Exploring Swing –JFrame, JLabel, JButton, JTextField	1 hour

AIL 411	DEEP LEARNING LAB	CATEGORY	L	T	P	CREDIT
		LAB	0	0	3	2

Preamble: This course aims to offer students hands-on experience on deep learning algorithms. Students will be able to familiarize basic python packages for deep learning, computer vision concepts for deep learning, sequence modelling, recurrent neural network also. This course helps the learners to enhance the capability to design and implement a deep learning architecture for a real time application.

Prerequisite: A sound knowledge in python programming, machine learning concepts, deep learning algorithms.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Implement advanced machine learning concepts using python.**(Cognitive Knowledge Level: Apply)**
CO 2	Applybasic data pre-processing and tuning techniques. **(Cognitive Knowledge Level: Apply)**
CO 3	Implement basic neural network and CNN on standard datasets. **(Cognitive Knowledge Level: Apply)**
CO 4	Design and Implement sequence modelling schemes.**(Cognitive Knowledge Level: Apply)**
CO 5	Implement auto encoders on standard datasets and analyse the performance. **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	✓	✓	✓	✓	✓			✓		✓		✓
CO 2	✓	✓	✓	✓	✓			✓		✓		✓
CO 3	✓	✓	✓	✓	✓	✓		✓		✓		✓
CO 4	✓	✓	✓	✓	✓	✓		✓		✓		✓
CO 5	✓	✓	✓	✓	✓	✓		✓		✓		✓

Assessment Pattern

Bloom's Category	Continuous Assessment Test %	End Semester Examination %
Remember	20	20
Understand	20	20
Apply	60	60
Analyze		
Evaluate		
Create		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva-voce : 15 marks

Internal Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

End Semester Examination Pattern: The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

Operating System to Use in Lab **:**Linux/Windows

Programming Language/Software to Use in Lab **:**matlab or python

Fair Lab Record:

All Students attending the Deep Learning Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

SYLLABUS

Familiarize python frameworks for deep learning, Data Preprocessing, Supervised Unsupervised Learning, Design and Implementation of Simple Neural Networks, Back Propagation, Regularization, Dropout, Build and analyze deep learning architectures like CNN, RNN, LSTM, GRU, Autoencoders.

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Reference Books

1. Deep Learning with Python, by François Chollet, Manning, 2021
2. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
3. Neural Networks and Deep Learning, Aggarwal, Charu C., c Springer International Publishing AG, part of Springer Nature 2018

LIST OF PRACTICE QUESTIONS

1. Basic python programs in machine learning.
2. Implement Simple Linear Regression with Synthetic Data.**
3. Implement basic image enhancement operations such as histogram equalization, morphological operations. **
4. Data pre-processing operations such as duplicate or missing value management.
5. Implement Feed forward neural network with three hidden layers for classification on CIFAR-10 dataset. Design and train a neural network that achieves high accuracy in classifying the images into their respective classes. Test different hyper-parameters
6. Implement a feed forward neural network with three hidden layers for the CIFAR-10 dataset.Train the network using a baseline optimization algorithm, such as stochastic gradient descent (SGD) or Adam, without any specific weight initialization technique or regularization technique. Record the accuracy and loss during training. (a) Repeat

the training process with Xavier initialization for weight initialization. Compare the convergence speed and accuracy of the network with the baseline results. Analyze the impact of Xavier initialization on the network's performance. (b) Repeat the training process with Kaiming initialization for weight initialization. Compare the convergence speed and accuracy of the network with the baseline results. Analyze the impact of Kaiming initialization on the network's performance. (c) Implement dropout regularization by applying dropout to the hidden layers of the network. Train the network with dropout regularization and compare its performance with the baseline results. Analyze the impact of dropout on the network's performance in terms of accuracy and overfitting (d) Implement L1 or L2 regularization techniques by adding a regularization term to the loss function during training. Train the network with regularization and compare its performance with the baseline results. Analyze the impact of regularization on the network's performance in terms of accuracy and prevention of overfitting.**

7. Implement a Convolutional Neural Network (CNN) architecture for digit classification on the MNIST dataset. Design and train a CNN model that achieves high accuracy in recognizing handwritten digits.**
8. Digit classification using pre-trained networks like VGGnet-19 for MNIST dataset and analyse and visualize performance improvement. Explore transfer learning using Convolutional Neural Networks (ConvNets) as fixed feature extractors and fine-tuning for image classification. Analyze their performance on a new image classification task while comparing the fixed feature extractor approach with fine-tuning.**
9. Implement a Recurrent Neural Network (RNN) for review classification on the IMDB dataset. Design and train an RNN model to classify movie reviews as positive or negative based on their sentiment.**
10. Analyze and visualize the performance change while using LSTM (Long Short-Term Memory) and GRU (Gated Recurrent Unit) instead of a standard RNN (Recurrent Neural Network) for sentiment analysis on the IMDB dataset. Compare the performance of different RNN architectures and understand their impact on sentiment classification.**
11. Implement time series forecasting for the NIFTY-50 dataset. Design and train a model to predict future values of the NIFTY-50 stock market index based on historical data.**
12. Implement a shallow autoencoder and decoder network for machine translation using the Kaggle English to Hindi Neural Translation Dataset. Design and train a model to translate English sentences to Hindi by leveraging the power of autoencoders and decoders.**

13. Building meaningful machine learning models for Breast Cancer Wisconsin (Diagnostic) Dataset**.**
14. Visualize deep learning models and parameters using visual keras, sklearn/dTreeViz, ANN visualizer, Netron, NN-SVG or any similar tools.
15. Familiarize GUI deep learning frameworks such as deeplearning studio.

Note: Any suitable dataset and deep learning specific packages can be used. Number of epochs can be reduced to complete the training in the prescribed 3 hour lab sessions

** Mandatory Exercises

ADQ413	SEMINAR	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	2

Preamble: The course 'Seminar' is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do literature survey in a selected area ofstudy.
- To understand an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: **Apply**).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: **Analyze**).
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: **Create**).
CO4	Give a presentation about an academic document (Cognitive knowledge level: **Apply**).
CO5	Prepare a technical report (Cognitive knowledge level: **Create**).

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1		2	1					3
CO2	3	3	2	3		2	1					3
CO3	3	2			3			1		2		3
CO4	3				2			1		3		3
CO5	3	3	3	3	2	2		2		3		3

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the projectteam could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern

Total marks: 100, only CIE, minimum required to pass 50

Seminar Guide: 20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based onher/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

ADD415	PROJECT PHASE I	CATEGORY	L	T	P	CREDIT
		PWS	0	0	6	2

Preamble: The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7^{th} and 8^{th} semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7^{th} semester and two third in 8^{th} semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problemsolving.
- To foster innovation in design of products, processes orsystems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20 Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the groupand their involvement in all stages of execution of the project shall be ensured by the guide.Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)

EVALUATION RUBRICS for PROJECT Phase I: Interim Evaluation

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to finda topic from the guide. Theydo not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There weresuggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the planwasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for improvement.	Excellent evidence of enterprising and extensive project planning.Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation

Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding

1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [CO1]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. The methodologies are understoodto a large extent.	Shows clear evidence of having a well-defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [CO3]	10	The student does not show any interest in the project activities, and is a passive member.	The student show some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study [CO1]	10	The team has not done any preliminary work with respect to the analysis/modeling/ simulation/experiment/desig n/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish the phase I in an excellent manner. They have shown results to prove their progress.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentation and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There is scope for improvement. The presentation is satisfactory. Individual performance is good.	The project stages are extensively documented in the report. Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well-planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		**30**	**Phase - I Final Evaluation Marks: 30**			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-g	Report [CO6]	20	The prepared report is shallow and not as perstandard format. It does not follow proper organization.Contains mostly Unacknowledged content.Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standardformat and there are only a few issues. Organization of the report is good. Most of references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

SEMESTER – VII

MINOR

CSD481	MINI PROJECT	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	0	0	3	4	2019

Preamble: The objective of this course is to apply the fundamental concepts of different courses learned in respective Minor Streams: Software Engineering, Machine Learning and Networking. This course helps the learners to get an exposure to the development of application software/hardware solutions/ software simulations in the field of Computer Science and Engineering. It enables the learners to understand the different steps to be followed such as literature review and problem identification, preparation of requirement specification &design document, testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

Prerequisite:

A sound knowledge in courses studied in respective minor stream.

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Identify technically and economically feasible problems **(Cognitive Knowledge Level: Apply)**
CO2	Identify and survey the relevant literature for getting exposed to related solutions. **(Cognitive Knowledge Level: Apply)**
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (**Cognitive Knowledge Level: Apply)**
CO4	Prepare technical report and deliver presentation **(Cognitive Knowledge Level: Apply)**
CO5	Apply engineering and management principles to achieve the goal of the project **(Cognitive Knowledge Level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Lifelong learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks
150	**75**	**75**

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Project Guide **15 marks**

Project Report **10 marks**

Evaluation by the Committee (will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement) : **40 marks**

Student Groups with 4 or 5 members should identify a topic of interest in consultation with a Faculty Advisor/Project Coordinator/Guide. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives by strictly following steps specified in the teaching plan. Innovative design concepts, performance, scalability, reliability considerations, aesthetics/ergonomic, user experience and security aspects taken care of in the project shall be given due weight.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

End Semester Examination Pattern:

The marks will be distributed as

Presentation : **30 marks**
Demo : **20 marks**
Viva : **25 marks.**
Total : **75 marks**.

TEACHING PLAN

Students are expected to follow the following steps.

1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc.
3. Create Requirements Specification
4. Create Design Document . This may include designs like,
    a. System Architecture Design
    b. Application Architecture Design
    c. GUI Design
    d. API Design
    e. Database Design
    f. Technology Stack
5. Deployment, Test Run & Get Results
6. Prepare Project Report

Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman18, Bold; Heading 2 – Times New Roman16, Bold; Heading 3 – Times NewRoman14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.

- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and givenproper names/headings. Write figure title under the figure and table title above the table.

- **Suggestive order of documentation:**
  i. Top Cover
  ii. Title page
  iii. Certification page
  iv. Acknowledgement
  v. Abstract
  vi. Table of Contents
  vii. List of Figures and Tables
  viii. Chapters
  ix. Appendices, if any
  x. References/Bibliography

SEMESTER – VII

HONOURS

CST495	CYBER FORENSICS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	3	1	0	4	2019

Preamble: The course on Cyber Forensics aims at exploring the basics of Cyber Forensics and Cyber security, the forensic investigation process and principles and the different types of cybercrimes and threats. This course also focuses on the forensic analysis of File systems, the Network, the Windows and Linux Operating systems. The course gives a basic understanding of the forensics analysis tools and a deep understanding of Anti forensics practices and methods. All the above aspects are dealt with case studies of the respective areas.

Prerequisite: Knowledge in File Systems, Operating systems, Networks and a general awareness on Cyber Technologies.

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain thebasic concepts in Cyber Forensics, Forensics Investigation Process and Cyber security(**Cognitive Knowledge Level: Understand**)
CO2	Infer the basic concepts of File Systems and its associated attribute definitions (**Cognitive Knowledge Level: Understand)**
CO3	Utilize the methodologies used in data analysis and memory analysis for detection of artefacts**(Cognitive Knowledge Level: Apply)**
CO4	Identify web attacks and detect artefacts using OWASP and penetration testing. **(Cognitive Knowledge Level: Apply)**
CO5	Summarize anti-forensics practices and data hiding methods **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓				✓						✓
CO2	✓	✓										✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓	✓							✓
CO5	✓	✓			✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test1 (Percentage)	Test2 (Percentage)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Tests : 25 marks

Continuous Assessment Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks.

First Internal Examination shall be preferably conducted after completing the first half of the syllabus and the Second Internal Examination shall be preferably conducted after completing remaining part of the syllabus.

There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly covered module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly covered module), each with 7 marks. Out of the 7 questions in Part B, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module-1(Cyber Forensics and Cyber Security)

Computer Forensics: History of computer forensics, preparing for computer investigations, understanding Public and private investigations- Forensics Investigation Principles - Forensic Protocol for Evidence Acquisition - Digital Forensics -Standards and Guidelines - Digital Evidence – Data Acquisition - storage formats for digital evidence, determining the best acquisition method, contingency planning for image acquisitions, Cyber Forensics tools- Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert

Cyber Security: Cybercrimes, Types of Cybercrimes - Recent Data Breaches - Recent Cyber security Trends - Case Study: Sim Swapping Fraud, ATM Card Cloning, Hacking email for money, Google Nest Guard, Email Crimes, Phishing, Types of Phishing.

Module-2 (File System Forensics)

File system Analysis: FAT and NTFS concepts and analysis -File system category, Content category, Metadata category, File name category, Application category,Application-level search techniques, Specific file systems, File recovery, Consistency check. FAT data structure-Boot sector, FAT 32 FS info, directory entries, Long file name directory entries

Module-3 (Operating System Forensics)

Windows Forensics: Live Response- Data Collection- Locard's Exchange Principle, Order of Volatility Volatile and Non Volatile Data Live-Response Methodologies: Data Analysis- Agile Analysis, Windows Memory Analysis, Rootkits and Rootkit detection.

Linux Forensics: Live Response Data Collection- Prepare the Target Media, Format the Drive, Gather Volatile Information, Acquiring the Image, Initial Triage, Data Analysis- Log Analysis, Keyword Searches, User Activity, Network Connections, Running Processes, Open File Handlers, The Hacking Top Ten, Reconnaissance Tools

Module-4 (Network Forensics)

The OSI Model, Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools, Case Study: Wireshark. Web Attack Forensics: OWASP Top 10, Web Attack Tests, Penetration Testing.

Module-5 (Anti-Forensics)

Anti-forensic Practices - Data Wiping and Shredding- Data Remanence, Degaussing, Case Study: USB Oblivion, Eraser - Trail Obfuscation: Spoofing, Data Modification, Case Study: Timestamp – Encryption, Case Study: VeraCrypt, Data Hiding: Steganography andCryptography, Case Study: SilentEye, Anti-forensics Detection Techniques, Case Study: Stegdetect

Text Books

1. Bill Nelson, Amelia Phillips and Christopher Steuart, Computer forensics - Guide to Computer Forensics and Investigations, 4/e, Course Technology Inc.
2. Brian Carrier, File System Forensic Analysis, Addison Wesley, 2005.
3. Harlan Carvey, Windows Forensic Analysis DVD Toolkit, 2/e, Syngress.
4. Cory Altheide, Todd Haverkos, Chris Pogue,Unix and Linux Forensic Analysis DVD Toolkit, 1/e, Syngress.
5. William Stallings,Network Security Essentials Applications and Standards, 4/e, Prentice Hall
6. Eric Maiwald, Fundamentals of Network Security, McGraw-Hill, 2004.

References

1. Michael. E. Whitman, Herbert. J. Mattord, Principles of Information Security, Course Technology, 2011.
2. William Stallings, Cryptography and Network Security Principles and Practice, 4/e, Prentice Hall.
3. Niranjan Reddy, Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations, Apress, 2019.

Sample Course Level Assessment Questions

CourseOutcome1(CO1): Explain the Forensics principles and protocols for evidence acquisition.

Discuss the different cyber forensics tools used for image acquisition.

CourseOutcome2(CO2): Explain the pros and cons of NTFS and FAT File systems. Also give the challenges the investigators would face in extracting evidences from these file systems.

CourseOutcome3 (CO3): Apply any memory forensics methodologies/tools to extract volatile and nonvolatile data from a Windows based system.

CourseOutcome4 (CO4): Use web attacks test tools like netcraft to identify web application vulnerabilities of a particular site say **www.xyz.com**

Course Outcome 5 (CO5): Explain the different anti-forensics practices used to destroy or conceal data in order to prevent others from accessing it.

Model Question Paper

QP CODE:

Reg No: _____

Name:_____ **PAGES : 3**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST495

Course Name: Cyber Forensics

Max. Marks : 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. Distinguish between public and private investigations.

2. What are the three computer forensics data acquisitions formats?

3. List any three features of NTFS which are not in FAT.

4. Define the terms file slack, RAM slack and drive slack.

5. What is Locard's exchange principle? Why is it important in forensic investigations?

6. Why would you conduct a live response on a running system?

7. What are the different tools used in Network Forensics?

8. Explain how Risk Analysis and Penetration Testing are different.

9. Why we are using Steganography?

10. How is data wiping done in hard drive?

(10x3=30)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Discuss the different types of Cybercrimes. List the tools used for identifying Cyber Crimes. **(8)**

(b) Differentiate between Static acquisition and Live acquisition with example. **(6)**

OR

12. (a) Explain the principles of Digital Forensic Investigation? Why is it important? Comment. **(8)**

(b) When you perform an acquisition at a remote location, what should you consider preparing this task? **(6)**

13. (a) Discuss the FAT File Structure. **(8)**

(b) Does Windows NT use FAT or NTFS? Explain. **(6)**

14. (a) What is Metadata? Discuss the first 16 metadata records you would find in the MFT? **(6)**

(b) Explain the different data categories in a File System. **(8)**

15. (a) What is Agile requirement analysis? **(6)**

(b) Explain the different types of volatile information in a live response system. List any two tools used for obtaining volatile information. **(8)**

16. (a) What are the main live response methodologies? **(6)**

(b) What is Physical Memory Dump? Explain how a physical memory dump is analysed. **(8)**

17. (a) What is OWASP? Also mention the Top 10 web application vulnerabilities in 2021. **(8)**

(b) How would you setup Wireshark to monitor packets passing through aninternet router? **(6)**

18. (a) What are the goals of conducting a pentesting exercise? **(3)**

(b) Discuss the types of penetration testing methodologies. **(5)**

(c) Define OSI Layers. **(6)**

19. (a) How is Steganography done? **(7)**

(b) Why does data need Cryptography? **(4)**

(c) What is the difference between a Cryptographer and a Crypter? **(3)**

OR

20. (a) Explain the different types of Anti-forensics Detection Techniques. **(8)**

(b) What is Spoofing? How to prevent spoofing attack? **(6)**

TEACHING PLAN

Sl.No.	Contents	No of Lecture Hrs (44hrs)
Module-1 (Cyber Forensics and Cyber Security) (11 Hrs)		
1.1	History of computer forensics, preparing for computer investigations	1 hour
1.2	Understanding Public and private investigations- Forensics Investigation Principles	1 hour
1.3	Forensic Protocol for Evidence Acquisition	1 hour
1.4	Digital Forensics -Standards and Guidelines - Digital Evidence	1 hour
1.5	Data Acquisition - storage formats for digital evidence, determining the best acquisition method	1 hour
1.6	Contingency planning for image acquisitions, Cyber Forensics tools	1 hour
1.7	Challenges in Cyber Forensics, Skills Required to Become a Cyber Forensic Expert	1 hour
1.8	Cybercrimes, Types of Cybercrimes - Recent Data Breaches - Recent Cyber security Trends	1 hour
1.9	Case Study: Sim Swapping Fraud, ATM Card Cloning	1 hour
1.10	Case Study:Hacking email for money, Google Nest Guard	1 hour
1.11	Email Crimes, Phishing, Types of Phishing	1 hour
Module-2 (File System Forensics) (9 Hrs)		

2.1	FAT and NTFS concepts and analysis	1 hour
2.2	File system category, Content category	1 hour
2.3	Metadata category	1 hour
2.4	File name category,Application category	1 hour
2.5	Application-level search techniques	1 hour
2.6	Specific file systems, File recovery, Consistency check	1 hour
2.7	FAT data structure-Boot sector	1 hour
2.8	FAT 32 FS info, directory entries	1 hour
2.9	Long file name directory entries	1 hour
Module-3 (Operating System Forensics) (11 Hrs)		
3.1	Live Response- Data Collection- Locard's Exchange Principle	1 hour
3.2	Order of Volatility, Volatile and Non Volatile Data	1 hour
3.3	Live-Response Methodologies: Data Analysis- Agile Analysis	1 hour
3.4	Windows Memory Analysis	1 hour
3.5	Rootkits and Rootkit detection	1 hour
3.6	Linux Forensics: Live Response Data Collection	1 hour
3.7	Prepare the Target Media, Format the Drive, Gather Volatile Information	1 hour
3.8	Acquiring the Image, Initial Triage	1 hour
3.9	Data Analysis- Log Analysis, Keyword Searches, User Activity	1 hour

3.10	Data Analysis- Network Connections, Running Processes, Open File Handlers	1 hour
3.11	The Hacking Top Ten, Reconnaissance Tools	1 hour
Module-4 (Network Forensics) (7 Hrs)		
4.1	OSI Model	1 hour
4.2	Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts	1 hour
4.3	ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools	1 hour
4.4	Web Attack Forensics	1 hour
4.5	OWASP Top 10, Web Attack Tests	1 hour
4.6	Penetration Testing-1	1 hour
4.7	Penetration Testing.-2	1 hour
Module – 5 (Anti-Forensics) (6 Hrs)		
5.1	Anti-forensic Practices - Data Wiping and Shredding	1 hour
5.2	Data Remanence, Degaussing	1 hour
5.3	Trail Obfuscation: Spoofing, Data Modification	1 hour
5.4	Role of Encryption in Forensics	1 hour
5.5	Data Hiding: Steganography and Cryptography	1 hour
5.6	Anti-forensics Detection Techniques	1 hour

AIT 497	COMPUTATIONAL HEALTH INFORMATICS	CATEGORY	L	T	P	Credit
		Honours	3	1	0	4

Preamble:

This course helps learners to develop know-how in computational methods, algorithms, and tools commonly used in health informatics. This includes data mining, machine learning, statistical analysis, and visualization techniques. Also, the course helps to gain knowledge of applications of machine learning in healthcare and how to analyze medical images, interpret healthcare data, and understand the role of informatics in disease diagnosis

Prerequisite: Basic background in Programming, Computational Biology and Machine learning

Course Outcomes: After the completion of the course, the student will be able to

CO 1	Describe health informatics, including its principles, concepts, and applications of computational methods and techniques used in health informatics (**Cognitive knowledge level: Understand**)
CO 2	Illustrate latest trends, advancements, and emerging technologies in computational health informatics(**Cognitive knowledge level: Apply)**
CO 3	Demonstrate application of computational methods and techniques to analyze and manipulate medical images for various purposes, such as diagnosis, treatment planning, and research (**Cognitive knowledge level: Apply)**
CO 4	Use the machine learning techniques to health images to aid in various aspects of healthcare, including diagnosis, treatment planning, and disease monitoring (**Cognitive knowledge level: Apply)**
CO 5	Implement deep learning techniques to analyze and interpret medical images (**Cognitive knowledge level: Apply**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										✓
CO2	✓	✓	✓	✓	✓							✓
CO3	✓	✓	✓	✓	✓							✓
CO4	✓	✓	✓	✓								✓
CO5	✓	✓			✓							✓

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	Test1 (%)	**Test2 (%)**	
Remember	**30**	**30**	**30**
Understand	**50**	**50**	**50**
Apply	**20**	**20**	**20**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance **10 marks**

Continuous Assessment Tests (Average of Series Tests 1& 2) **25 marks**

Continuous Assessment Assignment **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS`

Module -01 (Introduction to Health Informatics)

Definition, scope, and objectives of health informatics, Historical development and current trends in health informatics, Health informatics frameworks and models, Health data standards (HL7, SNOMED CT, ICD, etc.), Interoperability challenges and solutions, Data capture, storage, and retrieval in health informatics, Data quality and integrity, Data analytics techniques and applications in healthcare, Data visualization for decision support

Module-02 (Emerging Technologies in Health Informatics)

Artificial intelligence (AI) and machine learning in healthcare, Internet of Things (IoT) and its applications in healthcare, Hybrid IoT-NG-PON system, Blockchain technology in health informatics, Clinical research informatics, Genome sequencing and translational bioinformatics approach to genomics and precision medicine, IoT devices for healthcare, IoT beneficiaries in healthcare, IoT architecture, Data sharing and secondary use of health data

Module-03 (Medical Image Processing)

Overview of medical image processing and its significance in healthcare, Challenges and opportunities in medical image analysis, Principles of X-ray imaging, Magnetic Resonance Imaging (MRI) basics, Computed Tomography (CT) fundamentals, Ultrasound imaging and its characteristics, Image Enhancement Techniques, Contrast enhancement methods for

medical images, Noise reduction and image denoising techniques, Image sharpening and edge enhancement,

Module-04 (Machine Learning in Medical Image Analysis)

Image Segmentation, Thresholding techniques for image segmentation, Region-based segmentation algorithms, Edge detection and contour-based segmentation, Feature Extraction and Representation, Supervised and unsupervised learning algorithms, Classification and regression techniques for medical image analysis, Performance evaluation and validation of machine learning models

Module-05 (Deep Learning for Medical Image Processing)

Convolutional Neural Networks (CNNs) for medical image analysis, Segmentation and object detection using deep learning, Transfer learning and pretrained models in medical imaging, Volumetric image analysis and 3D reconstruction, Image-based modeling and simulation, Advanced imaging modalities (functional MRI, diffusion tensor imaging), Artificial intelligence in medical image processing

Books

1. Translational Bioinformatics in Healthcare anMedicine. (2021). Netherlands: Elsevier Science.
2. Computational Analysis and Deep Learning for Medical Care: Principles, Methods, and Applications. (2021). United Kingdom: Wiley.

References

1. Introduction to Computational Health Informatics. United States (2020) CRC Press.
2. Signal Processing Techniques for Computational HealthInformatics. (2020). Germany: Springer International Publishing.
3. Computational Intelligence and Healthcare Informatics. (2021). UnitedKingdom: Wiley.
4. Computational Intelligence for Machine Learning and Healthcare Informatics. (2020). Germany: De Gruyter.
5. Smart Computational Intelligence in Biomedical and Health Informatics. (2021). United States: CRC Press.
6. Healthcare Systems and Health Informatics: Using Internet of Things. (2022). United States: CRC Press.
7. Deep Learning Techniques for Biomedical and Health Informatics. (2020). United Kingdom: Elsevier Science.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Summarize Health informatics frameworks and models
2. Explain Health data standards HL7, SNOMED CT and ICD
3. Illustrate data analytics techniques and applications in healthcare

Course Outcome 2 (CO2):

1. Explain Blockchain technology in health informatics.
2. Illustrate Internet of Things (IoT) and its applications in healthcare with examples
3. How can translational bioinformatics facilitate the identification of disease-associated genetic variants and the development of targeted therapies?

Course Outcome 3 (CO3):

1. Differentiate principles and fundamentals of X-ray imaging, MRI, and CT
2. Explain the importance of image enhancement techniques in medical imaging and how they contribute to improved diagnosis and treatment
3. Explain the concept of edge detection in medical imaging and its role in image sharpening and feature extraction.

Course Outcome 4 (CO4):

1. Explain the concept of image segmentation and its significance in medical image analysis and diagnosis.
2. Compare and contrast different supervised learning algorithms used in medical image analysis

Course Outcome 5 (CO5):

1. Explain the process of training a CNN for medical image analysis, including data preprocessing, feature extraction, and backpropagation.
2. Discuss the potential benefits of applying AI in medical image processing, including improved accuracy, efficiency, and diagnostic outcomes.

TEACHING PLAN

No	Contents	No of Lecture (45Hrs)
Module -01 (Introduction to Health Informatics) (9hrs)		
1.1	Definition, scope, and objectives of health informatics	1
1.2	Historical development and current trends in health informatics	1
1.3	Health informatics frameworks and models,	1
1.4	Health data standards (HL7, SNOMED CT, ICD)	1
1.5	Interoperability challenges and solutions	1
1.6	Data capture, storage, and retrieval in health informatics	1
1.7	Data quality and integrity	1
1.8	Data analytics techniques and applications in healthcare	1
1.9	Data visualization for decision support	1
Module-02 (Emerging Technologies in Health Informatics)(9hrs)		
2.1	Artificial intelligence (AI) and machine learning in healthcare	1
2.2	Internet of Things (IoT) and its applications in healthcare	1
2.3	Hybrid IoT-NG-PON system	1
2.4	IoT devices for healthcare	1
2.5	IoT beneficiaries in healthcare, IoT architecture	1
2.6	Blockchain technology in health informatics	1
2.7	Clinical research informatics	1
2.8	Translational bioinformatics	1

2.9	Data sharing and secondary use of health data	1
Module-03 (Medical Image Processing) (10hrs)		
3.1	Overview of medical image processing and its significance in healthcare	1
3.2	Challenges and opportunities in medical image analysis	1
3.3	Principles of X-ray imaging	1
3.4	Magnetic Resonance Imaging (MRI) basics	1
3.5	Computed Tomography (CT) fundamentals	1
3.6	Ultrasound imaging and its characteristics	1
3.7	Image Enhancement Techniques	1
3.8	Contrast enhancement methods for medical images	1
3.9	Noise reduction and image denoising techniques	1
3.10	Image sharpening and edge enhancement	1

Module-04 (Machine Learning in Medical Image Analysis) (8hrs)		
4.1	Image Segmentation, Thresholding techniques for image segmentation	1
4.2	Region-based segmentation algorithms	1
4.3	Edge detection and contour-based segmentation	1
4.4	Feature Extraction and Representation	1
4.5	Supervised and unsupervised learning algorithms for medical image analysis	1
4.6	Classification techniques for medical image analysis	1
4.7	Regression techniques for medical image analysis	1
4.8	Performance evaluation and validation of machine learning models	1
Module-05 (Deep Learning for Medical Image Processing)(9hrs)		
5.1	Convolutional Neural Networks (CNNs) for medical image analysis	1
5.2	Segmentation and object detection using deep learning	1
5.3	Transfer learning and pretrained models in medical imaging	1
5.4	Volumetric image analysis and 3D reconstruction	1
5.5	Image-based modeling and simulation	1
5.6	Advanced imaging modalities (functional MRI)	1
5.7	Advanced imaging modalities (diffusion tensor imaging)	1
5.8	Artificial intelligence in medical image processing	1
5.9	Artificial intelligence in medical image processing Challenges	1

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES: 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 497

Course Name: COMPUTATIONAL HEALTH INFORMATICS

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1.	Compare and contrast the techniques, SNOMED CT and ICD	**3**
2.	List any three tools commonly used for data visualization in healthcare decision support within the field of Health Informatics with their use.	**3**
3.	Give examples of specific use cases where blockchain can improve healthcare systems.	**3**
4.	List any three IoT devices for healthcare with application.	**3**
5.	Explain the basic principles of Magnetic Resonance Imaging?	**3**
6.	Specify the different categories of image enhancement techniques used in health informatics.	**3**
7.	Give examples of different types of medical image segmentation techniques and applications.	**3**
8.	List of any three commonly used supervised and unsupervised learning algorithms for medical image analysis.	**3**
9.	Draw the architecture of a typical CNN.	**3**
10.	Give the concept of functional MRI and its applications.	**3** **(10x3=30)**

Part B
(Answer any one question from each module. Each question carries 14 Marks)

11.	(a)	Explain the purpose and role of HL7 standards in healthcare data interoperability. Provide examples of HL7 standards commonly used in clinical settings.	**(7)**

	(b)	Discuss the privacy and security concerns related to data capture, storage, and retrieval in health informatics. What are some strategies and best practices to mitigate these concerns and protect patient information?	**(7)**
		OR	
12.	(a)	Explain the importance of standardizing health data using controlled vocabularies and classifications like SNOMED CT and ICD. What are the benefits of using standardized codes?	**(7)**
	(b)	Discuss the importance of data capture in health informatics. Explain the different methods of data capture used in healthcare settings.	**(7)**
13.	(a)	Discuss the impact of emerging technologies on health informatics, highlighting their potential benefits and challenges in the healthcare industry.	**(7)**
	(b)	Explain the concept of precision medicine and its relationship with translational bioinformatics. How can bioinformatics tools and techniques contribute to the development of personalized treatment approaches?	**(7)**
		OR	
14.	(a)	Describe the potential uses of IoT devices in healthcare and discuss their impact on patient care and health monitoring.	**(7)**
	(b)	Discuss the types of machine learning algorithms commonly used in healthcare. Provide examples of supervised, unsupervised, and reinforcement learning algorithms and describe their specific applications in healthcare settings.	**(7)**
15.	(a)	Describe the characteristics of ultrasound waves used in imaging. How does ultrasound utilize sound waves to create images of internal body structures?	**(7)**
	(b)	Explain the concept of contrast enhancement in medical image processing. Why is contrast enhancement important in improving the visual quality and diagnostic utility of medical images?	**(7)**
		OR	
16.	(a)	Discuss the challenges in medical image analysis posed by the complexity and variability of anatomical structures and diseases. How can these challenges be addressed to improve the accuracy and reliability of image analysis?	**(7)**
	(b)	Describe the different types of noise commonly encountered in medical images. Why is it necessary to remove or reduce noise to improve medical images' visual quality and interpretability?	**(7)**
17.	(a)	Describe the basic principles of supervised learning for classification in medical image analysis. Discuss the steps involved, including data preparation, feature extraction, model training, and model evaluation.	**(7)**
	(b)	Discuss the concept of training, validation, and testing datasets in machine learning. Discuss the purpose of each dataset and their roles in evaluating model performance and generalization.	**(7)**

OR			
18.	(a)	How do regression techniques contribute to tasks such as disease prognosis, treatment response prediction, and quantitative analysis in healthcare?	**(7)**
	(b)	Discuss the application of edge detection and edge-based features in medical image analysis. List any two edge detection algorithms which can be used to extract edge-based features with their pros and cons	**(7)**
19.	(a)	Evaluate the future prospects and advancements in volumetric image analysis and 3D reconstruction in health. Discuss emerging technologies and trends in healthcare.	**(7)**
	(b)	Discuss the challenges and considerations in object detection and segmentation using deep learning.	**(7)**
OR			
20.	(a)	Explain the concept of diffusion tensor imaging and its significance in medical imaging. Discuss how diffusion tensor imaging captures and measures the diffusion of water molecules in biological tissues.	**(7)**
	(b)	Explain the challenges associated with variability in medical images. Also, explain the challenges of model interpretability and explainability in AI-based medical image processing	**(7)**

AIT 499	SURVEILLANCE VIDEO ANALYTICS	**Category**	**L**	**T**	**P**	**Credit**
		Honors	**3**	**1**	**0**	**4**

Preamble:

This course provide a comprehensive understanding of the principles, techniques, and applications of video analytics in the field of surveillance. The ability to extract meaningful insights and actionable intelligence from surveillance videos is crucial for enhancing situational awareness, detecting anomalies, and making informed decisions. **Prerequisite:** Basic knowledge in set theory.

Prerequisite: Basic concepts in Basic Image Processing and video analytics

Mapping of course outcomes with program outcomes

CO1	Use the probability concepts, statistical pattern recognition to analyze image and video **(Cognitive Knowledge level: Apply)**
CO2	Demonstrate knowledge and skills to effectively preprocess and post-process data **(Cognitive knowledge level: Apply)**
CO3	Explain the video analytic architectures, hardware devices, classification trees, and various algorithms for attribute classification **(Cognitive Knowledge level: Understand)**
CO4	Describe the techniques and algorithms in video processing and motion estimation **(Cognitive Knowledge level: Understand)**
CO5	Demonstrate the concepts of video coding **(Cognitive Knowledge level: Apply)**

Mapping of course outcomes with program outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											✓
CO2	✓	✓	✓									✓
CO3	✓	✓										✓
CO4	✓	✓										✓
CO5	✓	✓	✓	✓	✓							✓

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance	**10 marks**
Continuous Assessment Tests(Average of Internal Tests1&2)	**25 marks**
Continuous Assessment Assignment	**15 marks**

Internal Examination Pattern

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Fundamentals and Requirements)

Probability concepts, Sampling Concepts, Generating Random Variables, Exploratory Data Analysis, Monte Carlo Methods for Inferential Statistics, Data Partitioning, Probability Density Estimation, Statistical Pattern Recognition, and Nonparametric Regression.
Basic image analysis, and the four core analytics categories used in video surveillance; VMD, Heuristics, Conventional Object Detection, and Deep Learning Object Detection(Basics) deep learning neural networks for video analytics, datasets for neural network training (e.g. COCO, ImageNet, Pascal2, Wider, Government datasets)

Module - 2(Pre-processing and Feature Extraction)

Preprocessing and Post processing in data mining – Steps in Preprocessing, Discretization, Manual Approach, Binning, Entropy- based Discretization, Gaussian Approximation, K-tile method, Chi Merge, Feature extraction, selection and construction, Feature extraction Algorithms, Feature selection, Feature construction, Missing Data, Post processing

Module - 3 (**Video analytic architecture**)

Video analytic architectures, video analytic hardware devices, Classification trees, Algorithms for Normal Attributes, Information Theory and Information. Entropy, Building tree, Highly-Branching Attributes, ID3 to c4.5, CHAID, CART, Regression Trees, Model Trees, Pruning.

Module - 4 (**Steps of Video Processing**)

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm

Module - 5 (**Motion Estimation**)

Motion estimation: Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Coding: Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Text Books

1. Richard Szeliski , Computer Vision: Algorithms and Applications, A free electronic copy is available online.
2. Emanuele Trucco and Alessandro Verri, Introductory techniques for 3-D Computer Vision,

Reference Books

1. Multiple View Geometry in Computer Vision (2nd edition) by Richard hartley and Andrew Zisserman
2. Computer Vision: A Modern Approach by David Forsyth and Jean Ponce.
3. Digital Image Processing (Rafael Gonzalez and Richard Woods)
4. Yao wang, Joem Ostarmann and Ya – quin Zhang, Video processing and communication ,1st edition , PHI.
5. M. Tekalp , Digital video Processing, Prentice Hall International

Course Level Assessment Questions

Course Outcome1 (CO1):

1. Explain Monte Carlo Simulation.
2. Discuss the importance of data partitioning in data mining and statistical analysis
3. Explain the concept of deep learning object detection and its significance in computer vision applications.

Course Outcome 2(CO2):

1. Explain the concept of entropy-based discretization in data mining and its role in feature transformation

2. Discuss the challenges and techniques associated with handling missing data in Video analysis.
3. Explain the concept of binning in data preprocessing and its significance in handling continuous variables. Discuss the steps involved in the binning process, including defining bin boundaries, assigning data points to bins, and aggregating data within each bin.

Course Outcome 3 (CO3):

1. Describe the components and architecture of video analytics systems. Explain the key elements involved in video analytic architectures, including hardware devices, software algorithms, and network infrastructure.
2. Discuss the different discretization techniques, such as equal-width binning, equal-frequency binning, and entropy-based discretization.
3. Describe the concept of feature construction in machine learning and its role in enhancing the predictive power of models

Course Outcome 4(CO4): .

1. Explain the concept of geometric image formation in computer vision and its role in understanding the relationship between the 3D world and 2D image observations
2. Discuss the concept of filtering operations in video processing and their significance in enhancing visual quality and extracting relevant information.
3. Explain the concept of the block matching algorithm in motion estimation and its significance in video analysis

Course Outcome 5(CO5):

1. Describe the concept of mesh-based motion estimation in video analysis and its role in accurately tracking object motion
2. Explain the concept of multi-resolution motion estimation in video analysis and its significance in capturing motion information at different levels of detail.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____ **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: AIT 499

Course Name SURVEILLANCE VIDEO ANALYTICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1. List the pre and post processing techniques used in data mining.
2. Discuss the importance of data partitioning in data mining and statistical analysis.
3. List the data compression technique used in decision tree and types of pruning.
4. Derive the optical flow constraint equation.
5. Explain Gaussian Approximation and its relevance in data analysis.
6. Give the different video analytic architectures available, and specify how they contribute to video analytics.
7. How can 3D motion models be applied in the field of augmented reality (AR)?
8. List any three potential applications of optical flow in computer vision and video analysis?
9. Derive the equation for mesh-based motion estimation technique.

10. How does block-based transform coding contribute to video compression by exploiting spatial and temporal redundancies? **(10x3=30)**

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11. (a) Describe the Monte Carlo method for inferential statistics, steps involved and its significance in addressing complex statistical problems. **(7)**

(b) Explain the concept of conventional object detection in computer vision and its key components. **(7)**

OR

12. (a) Define random variables in probability theory and explain their significance in statistical analysis **(7)**

(b) Define the four core analytics categories used in video surveillance **(7)**

13. (a) Explain the importance of preprocessing and postprocessing in data mining and their respective roles in the overall Video analysis process **(14)**

OR

14. (a) Explain the k-tile method in inferential statistics, its steps, purpose, and significance. **(7)**

(b) Explain the Chi-Merge algorithm used in statistical analysis for merging adjacent intervals in a discretized dataset **(7)**

15. (a) Discuss how entropy is calculated and interpreted for various video analysis tasks. **(7)**

(b) Explain Regression Trees (CART) algorithm in machine learning, the key steps involved in building CART models. **(7)**

OR

16. (a) Describe the algorithm for handling normal attributes in statistical analysis. **(7)**

(b) Explain the concepts of regression trees and pruning in decision tree-based modeling. **(7)**

17. (a) Explain in detail the steps involved in structure from motion (SSM) method for 3D reconstruction. **(14)**

OR

18. **(a)** Describe the pixel-based motion estimation in video analysis, its principles, methodologies, and applications. **(7)**

(b) Describe the concept of mesh-based motion estimation in video analysis and its role in accurately tracking object motion **(7)**

19. (a) Explain the concept of multi-resolution motion estimation in video analysis and its significance in capturing motion information at different levels. **(14)**

OR

20. (a) Discuss the various applications of motion estimation in video coding. **(14)**

Teaching Plan

Module - 1 (Fundamentals and Requirements)		(10 hours)
1.1	Probability concepts, Sampling Concepts, Generating Random Variables	2 hour
1.2	Exploratory Data Analysis, Monte Carlo Methods for Inferential Statistics, Data Partitioning, Probability Density Estimation, Statistical Pattern Recognition, and Nonparametric Regression.	3 hour
1.3	Basic image analysis, and the 4 core analytics categories used in video surveillance;	2 hour
1.4	VMD, Heuristics, Conventional Object Detection, and Deep Learning Object Detection, deep learning.	2 hour
1.5	neural networks for video analytics, datasets for neural network training (e.g. COCO, ImageNet, Pascal2, Wider, Government datasets)	1 hour
Module - 2 (Pre-processing and Feature Extraction)		(9 hours)
2.1	Preprocessing and Post processing in data mining – Steps in Preprocessing	1 hour
2.2	Discretization, Manual Approach, Binning	2 hour
2.3	Entropy- based Discretization, Gaussian Approximation	1 hour
2.4	K-tile method, Chi Merge	1 hour
2.5	Feature extraction algorithms	1 hour
2.6	Feature selection	1 hour
2.7	Feature construction	1 hour
2.8	Missing Data, Post processing	1 hour
Module - 3 (Video analytic architecture)		(9 hours)
3.1	Video analytic architectures, video analytic hardware devices	2 hour
3.2	Classification trees, Algorithms for Normal Attributes	2 hour
3.3	Information Theory and Information. Entropy,Building tree	2 hour
3.4	Highly- Branching Attributes, ID3 to c4.5	1 hour
3.5	CHAID, CART	1 hour
3.6	Regression Trees, Model Trees, Pruning.	1 hour
Module - 4 (Steps in video processing)		(9 hours)
4.1	Basic Steps of Video Processing: Analog video, Digital Video sampling	1 hour
4.2	Time varying Image Formation models : 3D motion models	2 hour
4.3	Geometric Image formation , Photometric Image formation	2 hour
4.4	video signals, filtering operations	1 hour

4.5	2-D Motion Estimation: Optical flow, general methodologies	2 hour
4.6	pixel based motion estimation, Block matching algorithm.	1 hour
Module - 5 (Video Compression)		(8 hours)
5.1	Motion estimation: Mesh based motion Estimation, global Motion estimation	2 hour
5.2	Region based motion estimation	1 hour
5.3	multi resolution motion estimation	1 hour
5.4	Coding: Waveform based coding	1 hour
5.5	Block based transform coding	1 hour
5.6	predictive coding	1 hour
5.7	Application of motion estimation in video coding.	1 hour