

END-SEMESTER EXAMINATION, May-2024
Applied Linear Algebra (MTH 3003)

Programme: B.Tech (ALL Branch except ME)
Full Marks: 60

Semester: 4th
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Apply Gauss elimination principle to solve system of linear equations and elementary matrices to get LU & LDU factorization of a matrix.	L3, L3, L3 L3, L3, L3	1 (a), (b), (c), 2 (a), (b), (c)	2+2+2 2+2+2
Explain vector space, subspace, null space and column space, linear independence, basis and dimension of vector space and four fundamental subspaces, linear transformations and their applications.	L3, L3, L3	3 (a), (b), (c),	2+2+2
Explain basis and dimension of vector space and four fundamental subspaces, linear transformations and their applications.	L3, L3, L3	4 (a), (b), (c)	2+2+2
Explain orthogonality and its applications to find best fit solutions by least squares. Apply properties of determinants to solve the system of equations.	L3, L3, L3	5 (b), 7 (a), 7 (b), 8 (a)	2 2+2 2
Explain eigenvalues and eigenvectors and their application to solve system of differential equations and apply it to complex matrices, diagonalization of matrix.	L3, L3, L3 L3, L3, L3 L3, L5, L3 L3, L5, L5	5 (a), (b), (c), 6 (a), (b), (c), 7 (c) 8 (b), (c), 9 (a), (b), (c)	2+2+2 2+2+2 2+2 2 2+2+2
Examine the positive definiteness of a form and its applications to test the extreme points, Singular Value Decomposition and pseudoinverse. Identify and analyze the norm and condition number of a matrix.	L3, L3, L3	10 (a), (b), (c),	2+2+2

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1.	(a)	Determine the value of d that makes the following system singular $2x + 5y + z = 0, 4x + dy + z = 2, y - z = 3.$	2
	(b)	Solve the system of equations using column picture method for the equations $x - y = 0, x + y = 4$	2
	(c)	Apply Gaussian elimination to solve the following system $x + y + z = 5, x + 2y + 3z = 7, x + 3y + 6z = 11$	2
2.	(a)	Express the following matrix as LU factorization. $A = \begin{bmatrix} 2 & 3 & 3 \\ 0 & 5 & 7 \\ 6 & 9 & 8 \end{bmatrix}$	2
	(b)	Determine two permutation matrices P_1 and P_2 so that $P_1 A P_2$ is lower triangular, where $A = \begin{bmatrix} 0 & 0 & 6 \\ 1 & 2 & 3 \\ 0 & 4 & 5 \end{bmatrix}$	2
	(c)	Use Gauss-Jordan method to determine the inverse of the following matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 6 \\ 0 & 0 & 3 \end{bmatrix}$	2
3.	(a)	Prove that the plane of vectors (b_1, b_2, b_3) that satisfies $b_3 - b_1 + 2b_2 = 0$ is a subspace of \mathbb{R}^3 .	2
	(b)	Let $P = \begin{bmatrix} 1 & 1 & -1 \\ 1 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$ and $Q = \begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$ be two matrices. Determine the rank of the matrix $P - Q$.	2
	(c)	Let A and B be two $n \times n$ matrices over real numbers. Then explain which of the following statements are true ? 1. $\text{rank}(AB) = \text{rank}(A)\text{rank}(B)$ 2. $\text{rank}(A+B) \leq \text{rank}(A) + \text{rank}(B)$	2
4.	(a)	Describe the subspace of \mathbb{R}^3 spanned by the three vectors $(0,1,1), (1,1,0)$ and $(0,0,0)$.	2
	(b)	Determine the dimension of the four fundamental subspaces of the following matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$	2

	(c)	Determine the right inverse (if exists) for the matrix $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$.	2
5.	(a)	Let p and q be real numbers such that $p^2 + q^2 = 1$. Then determine the eigenvalues of the matrix $\begin{bmatrix} p & q \\ q & -p \end{bmatrix}$.	2
	(b)	Consider a 2×2 matrix $M = [v_1 \ v_2]$, where, v_1 and v_2 are the column vectors. Suppose $M^{-1} = \begin{bmatrix} u_1^T \\ u_2^T \end{bmatrix}$ where u_1^T and u_2^T are the row vectors. Determine $u_1^T v_1, u_1^T v_2, u_2^T v_1$ and $u_2^T v_2$.	2
	(c)	Two eigenvalues of a 3×3 real matrix P are $(2 + \sqrt{-1})$ and 3. The determine the determinant of P .	2
6.	(a)	Solve the differential equation $\frac{du}{dt} = Au, u(0) = \begin{bmatrix} 0 \\ 0 \\ 6 \end{bmatrix}$ where A is $A = \begin{bmatrix} 1 & -1 \\ 2 & 4 \end{bmatrix}$.	2
	(b)	Determine the 10^{th} power of A after diagonalizing it. $A = \begin{bmatrix} 1 & -1 \\ 2 & 4 \end{bmatrix}$.	2
	(c)	Prove that for a unitary matrix, the eigenvectors corresponding to different eigenvalues are orthogonal.	2
7.	(a)	Determine the projection matrix P onto A^T for $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$.	2
	(b)	Solve the following system using Cramer's rule. $2x + 5y = 1$ $x + 4y = 2$	2
	(c)	If A is a 4×4 matrix with eigen values $5, 7, 8, 9$ then determine $\det(\frac{1}{2}A)$ and $\det(A^{-1})$.	2
8.	(a)	Compute area of the triangle of the triangle with vertices $A(2,2), B(-1,3)$ and origin in xy plane.	2

	(b)	Determine the eigenvalues and eigenvectors of AA^T and A^TA where $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix}$.	2
	(c)	Construct the matrix A whose eigenvalues are 2 and 3, and whose eigenvectors are and respectively.	2
9.	(a)	Determine the lengths and inner product of $x = \begin{bmatrix} 1 \\ i \end{bmatrix}$ and $y = \begin{bmatrix} 2+i \\ 2-4i \end{bmatrix}$.	2
	(b)	Discuss Hermitian Matrix with proper example. Also justify that the example given satisfies the required conditions.	2
	(c)	Decide for or against the positive definiteness of the following matrix. $A = \begin{bmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{bmatrix}$	2
10	(a)	Determine the Singular Value Decomposition and Pseudo-inverse of the matrix given in Q.8(b).	2
	(b)	Determine the norm and condition number of the matrix $A = \begin{bmatrix} 1 & 0 \\ 2 & 2 \end{bmatrix}$.	2
	(c)	Compute the Gauss- Seidel matrix of the matrix $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$.	2

End of Questions

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END-SEMESTER EXAMINATION, May-2024

Computer Organization and Architecture (EET2211)

Programme: B.Tech(CSE/CSIT)
Full Marks: 60

Semester: 4th
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Able to explain the concepts that underline the modern Computer evolution, function, and organization.	L2	1,6, 7(a),7(b)	16
Able to identify the appropriate organization of a computer for achieving the best performance.	L3	2	6
Able to analyze and demonstrate the computer function and interconnection.	L2	3	6
Able to understand and analyze the computer memory system.	L2	4,5	12
Able to understand and analyze computer arithmetic via digital logic.	L3	7(c), 8,9(a),9(b)	12
Able to interpret low level processor operations using a series of computer instructions.	L3	9(c), 10	8

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

- Answer all questions. Each question carries equal mark.
1. (a) Differentiate between CISC and RISC architecture. 2
 - (b) Briefly explain the basic functions of a computer. 2
 - (c) Explain the four generations of deployment in IoT? 2
 2. (a) Explain each variable that is related to Little's law. 2
- A doctor in a hospital observes that on average 6 patients per hour arrive and there are typically 3 patients in the hospital. What is the average length of time each patient spends in the hospital?
- (b) Describe any of the four techniques to increase the microprocessor speed. 2

(c)

- Compute the geometric mean for each system using X and Y as the reference machine, which shows the execution time in sec. 2

Benchmark	Processor		
	X	Y	Z
1	20	10	40
2	40	80	20

Argue the result obtained based on the performance.

3. (a) Describe the three key concepts of the von Neumann architecture. 2

- (b) Discuss the top-level view of computer components with a suitable block diagram. 2

- (c) Consider a hypothetical 32-bit microprocessor having 32-bit instructions composed of two fields: the first byte contains the opcode and the remainder the immediate operand or an operand address. 2

- i) What is the maximum directly addressable memory capacity (in bytes)?
ii) How many bits are needed for the program counter and the instruction register?

4. (a) Discuss the general relationship among access time, memory cost and capacity in the memory hierarchy of the computer system. 2

- (b) Explain the error correction process in the memory system using a suitable. 2

- (c) An 8-way set associative cache of size 64 KB is used in a system with 32-bit address. The address is sub-divided into TAG, INDEX, and BLOCK OFFSET. How many numbers of bits in the TAG field? 2

5. (a) How is the syndrome for the Hamming code interpreted? 2

- (b) Define and compare the RAID 0, and RAID 1 levels with suitable diagrams. 2

- (c) Suppose an 8-bit data word stored in memory is 11000010. Using the Hamming algorithm, determine what check bits would be stored in memory with the data word. What are the three broad classifications of external, or peripheral, devices? 2

6.

- (a) Discuss the structure of an I/O module with suitable block diagram. 2

- (b) Explain the steps involved in simple interrupt processing. Suppose that the 8255A is configured as follows: port A as output, port B as output, and all the bits of port C as input. Show the bits of the control register to define this configuration. 2

- (c) When a number of device interrupt occur, how does the processor determine which device issued the interrupt. Explain this determination of priorities among 8 devices with suitable block diagram. 2

7. (a) List and briefly define the key services provided by an OS. 2

- (b) Explain the memory layout for a resident monitor. 2

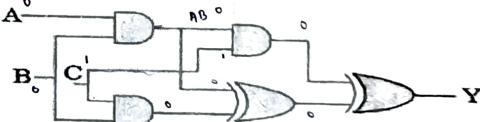
- (c) Convert the decimal number 204.125 to their binary equivalent and hexadecimal equivalent. 2

8. (a) Assume numbers are represented in 8-bit twos complement representation. Show the calculation of -6 + 13. 2

- (b) Compute the product of 7*5 with Booth's algorithm assuming each number represented in 4 bit long. 2

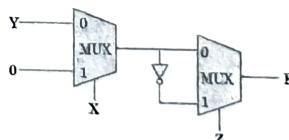
- (c) The number 0100000101011010000000000000000000 uses the IEEE 32-bit floating-point format. Determine its equivalent decimal value? 2

9. (a)



Write the Boolean expression of Y in terms of A, B, and C. What is the output Y for A=B=0 and C=1?

- (b)



Determine the Boolean expression of F in term of X, Y and Z.

- (c) Determine the contents of memory offset 6000H and 6001H after executing the following code. 2

```
MOV AL, 12H  
MOV BL, 06H  
MUL BL  
ADD AX, 0015H  
DIV BL  
MOV [6000H], AX  
HLT
```

- 10 (a) Discuss the addressing modes of ARM processor with suitable examples. 2
- (b) Write an assembly language program using 8086 instruction set to add first 10 natural numbers and store the result in memory offset 5000H. 2
- (c) Determine the content of registers and memory location. 2

```
LDR R0, =0x4532ABCD Cw  
MOV R1, #0x40  
ADD R0, R1, R0  
STR R0, [R1]  
MY_EXIT: B MY_EXIT
```

End of Questions

END-SEMESTER EXAMINATION, May-2024
ALGORITHM DESIGN-2 (CSE4131)

Programme: B.Tech (CSE/CSIT/CDS/CIOT/CAIML/CCS)

Semester: 4th

Full Marks: 60

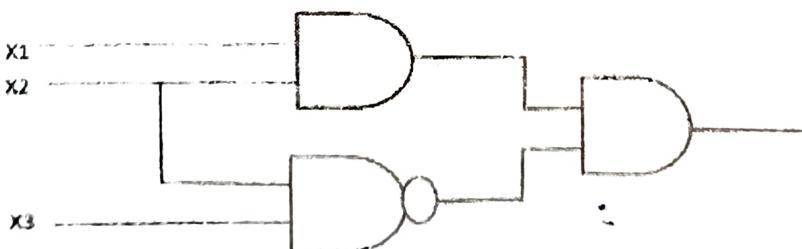
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
CO1: understand the network flow problem and apply it to real-world problems.	L2, L4, L5	1(a), 1(b), 1(c)	2+2+2
CO2: distinguish between computationally tractable and intractable problems define and relate class P, class NP and class, NPcomplete, PSPACE, PSPACE complete. given a problem in NP, define an appropriate certificate and the verification algorithm.	L1, L4, L5	2(a), 2(b), 2(c) 3(a), 3(b), 3(c) 4(a), 4(b), 4(c)	2+2+2 2+2+2 2+2+2
CO3: understand approximation algorithms and apply this concept to solve problems.	L3, L4, L5	5(a), 5(b), 5(c) 6(a), 6(b), 6(c)	2+2+2 2+2+2
CO4: understand local search techniques and apply this concept to solve problems.	L3, L4, L5	7(a), 7(b), 7(c)	2+2+2
CO5: understand randomization and apply this concept to solve problems.	L3, L4, L5	8(a), 8(b), 8(c) 9(a), 9(b), 9(c)	2+2+2 2+2+2
CO6: identify and apply an appropriate algorithmic approach to solve a problem and explain the challenges to solve it.	L5, L6	10(a), 10(b), 10(c)	2+2+2

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

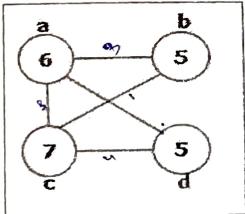
Answer all questions. Each question carries equal mark.

1. (a) Consider the given network flow graph $G(V, E)$, where $V = \{A, B, C, D, E, F, G\}$ and capacities of the edges in E are $c(A, B) = 8, c(B, C) = 10, c(C, G) = 16, c(A, D) = 11, c(D, E) = 9, c(E, G) = 12, c(B, F) = 7, c(F, C) = 13, c(D, F) = 8, c(F, E) = 9$. {Note: $c(u, v)=w$ means direction of edge is $u \rightarrow v$ with weight w }. Draw the flow graph and Identify the Source and Sink nodes with proper justification. 2
- (b) For the Flow Network in [Q(1a)], estimate the maximum flow with less number of iterations with proper justification for each of the iterations. 2
- (c) What can be the maximum number of edges in a residual graph at any arbitrary iteration for a given flow graph during the estimation of maximum flow? Justify your answer with a suitable example. 2
2. (a) Give a suitable relation between the problem classes P, NP, NPH, NPC and PSPACE? 2
- (b) Convert the given circuit to CNF. 2



- (r) Define the problem statement for a Decision Set Cover problem and show that it is in NPC. 2
- 3 (a) Convert the given 3-SAT problem instance to an instance of an Independent Set and find the maximal Independent Set. 2
The given 3-SAT is $\varphi(x) = (x_1 \vee \bar{x}_2 \vee x_3) \wedge (\bar{x}_1 \vee \bar{x}_2 \vee x_3) \wedge (\bar{x}_1 \vee x_2 \vee \bar{x}_3)$.
Suppose, the 3-SAT problem has k clauses, then it is satisfiable if and only if the corresponding graph has an independent set of size k . Now, give an example to show that 3-SAT is not satisfiable if and only if the corresponding graph does not have any independent set of size k .
- (c) What do you mean by a Certificate of a problem? What is the significance of the polynomial time certifier? 2
- 4 (a) Define PSPACE. Why Q-SAT \in PSPACE? 2
(b) Suppose $Y \leq_p X$. If Y cannot be solved in polynomial time, then X cannot be solved in polynomial time. True or False? Justify your answer. 2
(c) Given a Complete undirected Graph $G(V, E)$ with the total number of vertices are 8 i.e. $|V|=8$. Then there cannot be a vertex cover of size 3. True or False? Justify your answer.
- 5 Given an approximation algorithm for weighted-vertex-cover problem as below:
- Vertex-Cover-Approx(G, w)
Set $p_e = 0$ for all $e \in E$
While (there is an edge (i, j) such that neither i nor j is tight)
 Select such an edge e
 Increase p_e as much as possible until i or j tight}
 $S \leftarrow$ set of all tight nodes
return S
- (a) Using the above algorithm based on pricing method, find the weighted-vertex-cover for the given graph with four vertices having vertex weights/costs 6, 5, 7 and 5. 2
(b) Compare your solution with the optimal solution for this example. 2
(c) Show that "the set S returned by the above algorithm is a vertex cover, and its cost is at most twice the minimum cost of any vertex cover." 2
- 6 Given an approximation algorithm for weighted-set-cover problem as below:

```
Greedy-Set-Cover() {
    Start with  $R = U$  and no sets selected
    while ( $R \neq \emptyset$ ){
        Select set  $S_i$  that minimizes  $w_i / |S_i \cap R|$ 
         $S = S \cup \{S_i\}$ 
    }
}
```



Delete set S_i from R . // $R = R - \{S_i\}$

}
Return the selected sets S

}
Given Set-Cover instance with $U=\{1,2,3,4,5,6,7,8\}$, and list of subsets such as $S_1=\{1,3,5,7\}$, $S_2=\{2,4,6,8\}$, $S_3=\{1\}$, $S_4=\{2\}$, $S_5=\{3,4\}$, $S_6=\{5,6,7,8\}$ and weight array $w[] = \{1+\epsilon, 1+\epsilon, 1, 1, 1, 1\}$, where ϵ is a very small value between 0 and 1.

7. (a) Using the above algorithm, find the solution S for the given set-cover problem instance. 2
(b) Compare your obtained solution with the optimal solution S^* . 2
(c) Give a suitable match between the set A and B where $A=\{\text{NP-Complete, P, PSPACE, NP-hard}\}$ and $B=\{\text{Vertex Cover Optimization Problem, Planning Problem, Flow Network, TSP Decision Problem}\}$ 2

7. (a) Given an undirected weighted graph defines the configuration S , consists of a set of nodes $V=\{a, b, c, d, e, f\}$, set of edges $E=\{(a, b), (a, e), (a, f), (b, f), (b, c), (c, d), (e, d), (f, d)\}$. The associated edge weight set $W=\{-1, 4, 6, -5, 1, 2, -3, 9\}$. Consider the node assignment is $S_e = S_f = S_c = -1$ and for all other nodes it is +1. Draw the configuration S and find out all the good edges and bad edges of the given configuration. 2
(b) Make the configuration S of question [Q(7a)] into stable configuration using state-flipping algorithm. 2
(c) Apply gradient descent local search algorithm to find the vertex cover from the given complete bipartite graph $G=(V, E)$, where $V=L \cup R$, $L=\{a, b, c, d, e\}$, and $R=\{m, n, o, p, q, r\}$. Can gradient descent always guarantee finding the global optimum from a solution space? If not, why? 2

8. Select(S, k)
{Choose a splitter $a_i \in S$.
for each element a_j of S {
 if $a_j < a_i$ then put a_j in S^-
 if $a_j > a_i$ then put a_j in S^+
}
if $|S^-| = k - 1$ then
 return a_i // the splitter a_i was in fact the desired answer
else if $|S^-| \geq k$ then
 Select(S^-, k) // the k th largest element lies in S^-
 else // suppose $|S^-| = t < k - 1$
 Select($S^+, k - t - 1$) // the k th largest element lies in S^+

- (a) Given a set of elements {7, 4, 2, 10, 9, 3, 6, 13, 5, 11, 8, 1, 12}. Find the median of the array using the above algorithm. Show each steps of the computation, considering the leftmost element as the splitter. 2
- (b) If the splitter is an "off center" then what may be the recurrence relation of the above algorithm. Analyze the run time. 2
- (c) When we choose an element as a splitter of the set under consideration that at least quarter of the elements are smaller than it and at least a quarter the elements are larger than it. Then with this process give an upper bound of the run time of the algorithm. 2
- 9 (a) Demonstrate what happens when we insert the keys 5, 28, 19, 15, 20, 33, 12, 17, 10 into a hash table with collisions resolved by chaining. Let the table have 9 slots and the hash function is $h(x) = x \bmod 9$. 2
- (b) Let U be a universal set. Each element $x \in U$ is type of r-vector i.e $x = (x_1, x_2, \dots, x_r)$, where $0 \leq x_i < p$. Let $A = \{\text{set of all } r\text{-digits, } p\text{-base integers}\}$. For $a = (a_1, a_2, \dots, a_r) \in A$, where $0 \leq a_i < p$, define a hash function $h_a(x): U \rightarrow \{0, 1, \dots, p - 1\}$ such that $h_a(x) = (\sum_{i=1}^r a_i x_i) \bmod p$. Then, a class H of hash functions is called universal if $\Pr_{h \in H}[h(x) = h(y)] \leq 1/p$. Using the above hash function [Q(9b)], compute the hash value of the elements $x = (2,3)$, $y = (4,5)$, $z = (2,1)$ with $p=7$. Where $A = \{a, b\}$ $r = 2$ and $a = (3,5)$, $b = (1,3)$. 2
- (c) Find whether the $H = \{h_1, h_2\}$ in [Q(9b)] is a universal family of hash functions or not? 2
- 10 In a reserve forest, the forest department wants to keep an eye on animals and their movements. The department has a map of roads on which animal movements are observed. The department wants to deploy video cameras to capture live videos to be streamed. The department is concerned about deploying video cameras so efficiently that it can cover all the roads with the number of video cameras as little as possible. 2
- (a) Formulate the problem mathematically with an appropriate data structure. 2
- (b) What is your view on designing an algorithm to solve the problem? 2
- (c) Which algorithm design paradigm did you prefer and What are the challenges of the algorithm? 2

End of Questions

END-SEMESTER EXAMINATION, May-2024
Computer Science Workshop2 (CSE3141)

Programme: B.Tech(CSE/CSIT)
Full Marks: 60

Semester: 4th
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Understanding Object-oriented programming, generic and collection classes, and applying them to solve different problems.	L1, L2, L3	Q1	6
Understanding Error handling, garbage collection, string, I/O operation, and file management of Java. And apply it to solve related problems.	L1, L2, L3	Q2	6
Learning different data structures and applying them to solve different problems and analyzing their effectiveness in different problem-solving. Understanding and applying Lambdas and Functional programming using Java.	L1, L2, L3	Q3.Q 4 Q5,Q 6	12+12
Understanding multithreading and reactive programming of Java, and applying it to solve related problems.	L1, L2, L3	Q7,Q 8	12
Learning spring and spring MVC of Java and applying it to solve different problems.	L1, L2, L3	Q9,Q 10	12

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1.	(a)	Write a program to create Complex class, having member real and imaginary. Add the required constructor, set and get method.	2
	(b)	Create a class ComplexApp add a method that takes two complex object and find its summation. If any of the complex number is not in proper format it throws ComplexNumberFormat exception.	2
	(c)	Create a main function in ComplexApp for creation of the proper complex object handle the exception and call the methods for execution.	2
2.	(a)	Create a class, define a static function in the class, which takes a mathematical expression as its arguments and return the	2

	operator and operand present in the expression.	
	(b) Define a static function in the above created class which takes the return result of the above function and a file name as its argument. The function writes the return result in that file.	2
	(c) Create static function in the above created class which takes a file name and read the result and display it. Add a main function the created class to execute the above functions.	2
3.	(a) Create a class named Graph with members adj a two-dimensional matrix, n represent the number of nodes. Add the required method and constructor.	2
	(b) Create a GraphApp class add a method BFS(Graph g, int s) to it which traverse the graph using breadth first search.	2
	(c) Add a method DFS(Graph g) to GraphApp which traverses the graph using depth first search.	2
4.	(a) Add a method path(int s, int d) to GraphApp class which print the path between two node.	2
	(b) Add a method printAdj(int node) to GraphApp class which prints the adjacent of a given node.	2
	(c) Create a main method to invoke the above created method for execution. <i>Note: Write one program for Q3 and Q4.</i>	2
5.	(a) Write a program to create an Employee class that has members' empid, name, date of joining and date of birth. Date of joining and date of birth both are LocalDate type. Add the required constructor.	2
	(b) Add the required setter and getter methods.	2
	(c) Add a method to the Employee class which prints the age and years of experience of the employee.	2
6.	(a) Create another class EmpApp . Add a method to the emp class which takes two Employee object and print the senior among them according to experience .	2
	(b) Add a method to EmpApp which sort an array of Employee object according to empid. Use lambda function to override the compare/compareTo method.	2

	(c)	Call all the above created methods for execution. <i>Note: Write one program for Q5 and Q6.</i>	2
7.	(a)	Create a class named MyArray has member variable and int array and size of the array. Add the required method and set and get method to it.	2
	(b)	Add a synchronized method to MyArray which reads the number for the array.	2
	(c)	Add a method with synchronized block which prints the content of the array.	2
8.	(a)	Create a Thread class that reads the elements for the array.	2
	(b)	Create another Thread class that prints the elements of the array.	2
	(c)	Create ArrayApp class add the required method to create two thread one is for reading the elements of the array and another is for printing the elements of the array. <i>Note: Write one program for Q7 and Q8.</i>	2
9.	(a)	Create a Model class having members modelNo, number of cylinder. Add the required constructor, set and get method.	2
	(b)	Create a Car class having members name, color and Model. Add the required constructor, set and get methods.	2
	(c)	Create an xml file for creation of the object using spring inverse of controle.	2
10.	(a)	Create an xml file for dependency injection using property.	2
	(b)	Add lines to inject Model object which is the member of the Car class.	2
	(c)	Create a class CarApp to create the object of the Car class and print the details. <i>Note: The object is created by the above created xml file.</i> <i>Note: Write one program for Q9 and Q10.</i>	2

End of Questions

END-SEMESTER EXAMINATION, January - 2024

Principles of Macroeconomics (HSS2021)

Programme: B.Tech
Full Marks: 60

Semester: 3rd
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
CO1: Be able to analyze how different economies across the globe, gains from trade by using absolute and comparative advantage as the basis of trade.	L3, L3, L3	1.(a,b,c)	6
CO2: Be able to construct Consumer Price Index (CPI) and analyze its impact on the cost of living and standard of living of the consumers in an economy.	L3, L3,L3 L3	2.(a,b,c) 3(c)	6 6
CO3: Be able to measure national income and economic growth, and analyze their relationship with consumption, saving, investment, and productivity	L3, L3 L3, L3, L4 L3, L3, L4 L3, L4, L4	3.(a,b) 4.(a,b,c) 5.(a,b,c) 9.(a,b,c)	6 6 6 6
CO4: Be able to analyze the role of financial markets and financial intermediaries in coordinating the activities of the savers and investors, and various tools used in regulating money supply in the economy.	L3, L4, L3	8.(a,b,c)	6
CO5: Be able to analyze the economic feasibility of project proposals.	L3, L3, L3	6.(a,b,c)	6
CO6: Be able to measure unemployment, and analyze the short-run fluctuations in economic activities through aggregate demand and aggregate supply model.	L3, L3, L4 L3,L3,L3	7.(a,b,c) 10(a,b,c)	6

*Bloom's taxonomy levels: Remembering (L1), Understanding (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1.		<p>Here are the numbers of hours needed in Belarus and Belgium to produce a unit of television and computer.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Country</th><th style="text-align: center;">Television</th><th style="text-align: center;">Computer</th></tr> </thead> <tbody> <tr> <td style="text-align: center;">Belarus</td><td style="text-align: center;">18 hours</td><td style="text-align: center;">6 hours</td></tr> <tr> <td style="text-align: center;">Belgium</td><td style="text-align: center;">16 hours</td><td style="text-align: center;">4hours</td></tr> </tbody> </table>	Country	Television	Computer	Belarus	18 hours	6 hours	Belgium	16 hours	4hours	
Country	Television	Computer										
Belarus	18 hours	6 hours										
Belgium	16 hours	4hours										
	(a)	Compute the unit opportunity cost of producing television and computer both for Belarus and Belgium.	2									
	(b)	Identify which country has an absolute advantage in producing television and computer? Which country has the comparative advantage in producing television and computer?	2									
	(c)	Anna can read 200 pages of economics or 500 pages of history in 10 hours. She spends 5 hours per day studying .Graphically	2									

		represent Anna's production possibilities frontier for reading economics and history per day.													
2.	(a)	The cost of the basket at the end of 2022 was \$ 4200 and at the end of 2023 was \$ 4900. Assuming 2022 as the base year . Find the inflation rate for 2023.	2												
	(b)	Kiran earned Rs. 25,000 in 2020. How much would that be worth in 2023 dollars? Assuming the CPI was 150 in 2020 and 240 in 2023.	2												
	(c)	The New York Times cost \$0.15 in 1970 and \$2.00 in 2009. The average wage in manufacturing was \$3.23 per hour in 1970 and \$20.42 in 2009. By what percentage did the price of the newspaper and wage rise?	2												
3.		The following information given related to a hypothetical economy.													
		<table border="1"> <thead> <tr> <th>Year</th> <th>Quantity (Pen)</th> <th>Price (Pen)</th> </tr> </thead> <tbody> <tr> <td>2015</td> <td>500</td> <td>\$ 10</td> </tr> <tr> <td>2016</td> <td>525</td> <td>\$ 11</td> </tr> <tr> <td>2017</td> <td>530</td> <td>\$ 15</td> </tr> </tbody> </table>	Year	Quantity (Pen)	Price (Pen)	2015	500	\$ 10	2016	525	\$ 11	2017	530	\$ 15	
Year	Quantity (Pen)	Price (Pen)													
2015	500	\$ 10													
2016	525	\$ 11													
2017	530	\$ 15													
	(a)	Compute NGDP, RGDP & GDP Deflator in each of the year assuming 2015 as the base year.	2												
	(b)	What is the inflation rate in 2016 & 2017?	2												
	(c)	Ria spends Rs. 500/- in buying a star buck cup of coffee. Ria's sister Sia works in a shop for Rs. 200 per hour. Draw a circular flow diagram to demonstrate the flow of goods & services & the flow of rupees for these activities.	2												
4.	(a)	In 2020, the imaginary nation, Bluecenia had a population of 10,000 and a real GDP of \$20,00,000. Bluecenia had a 10% growth in real GDP and a 12% growth in population size from 2020 to 2021. Compute the economic growth rate of Bluecenia from 2020 to 2021.	2												
	(b)	Country A has a population of 1000, of whom 700 are workers, and has a real GDP of \$2450. Country B has a population of 700, of whom 600 are workers and has a real GDP of \$1800. From this hypothetical example, can we infer that a country with a higher standard of living enjoys a higher productivity? Justify your answer.	2												
	(c)	Some facts that at first might seem confusing: The share of GDP devoted to investment was similar for the United States and South Korea during 1960-1990. During this period South Korea experienced around a 6 percent growth rate, while the United States had only a 2 percent growth rate. Why were the growth rates so different despite the investment rates being the same for both countries? Analyse.	2												
5.	(a)	Economists in the US, a closed economy, have collected the following information for a particular year: $Y = \$10,000$ $C = \$6,000$; $T = \$1,500$; $G = \$1,700$, where Y , C , T , and G indicate GDP, Consumption expenditure by household, Tax revenue,	2												

		and Govt. purchase respectively.													
		The economists also estimate that the investment (I) function is: $I = 3300 - 100r$, where ' r ' indicates the real interest rate expressed as a percentage. Calculate the equilibrium real interest rate and amount of investment.													
	(b)	The following information is given relating to a hypothetical economy. $GDP = \$8$ trillion, tax revenue = \$1.5 trillion, private saving = \$0.5 trillion, and public saving = \$0.2 trillion. Assuming this economy is closed; calculate consumption, government purchases, national savings, and investment.	2												
	(c)	Assume the US government reduced the tax size on interest income. By using the demand and supply model of the loanable funds market, graphically analyze its effect on national saving and investment.	2												
6.	(a)	A person deposits a sum of Rs. 30,000 in SBI at the interest rate of 15% compounded annually for 10 years. Find the maturity value after 10 years.	2												
	(b)	Suppose that an investor wishes to deposit an amount now so that in 30 years Rs. 1,000,000 will be in an account that pays 10% interest per year, compounded annually. What amount must be deposited now?	2												
	(c)	Suppose that Rs. 1,000 is invested for six years at an interest rate of 10% per year, compounded annually. How much will be in the account at the end of six years?	2												
7.	(a)	In the city of Pretoria, the Bureau of Labor Statistics has released tabulated data on the adult populations in December 2020.	2												
		<table border="1"> <thead> <tr> <th>No. of Males & Females</th> <th>Not in Labor Force (in thousands)</th> <th>Unemployed (in thousands)</th> <th>Employed (in thousands)</th> </tr> </thead> <tbody> <tr> <td>Males</td> <td>38</td> <td>7</td> <td>90</td> </tr> <tr> <td>Females</td> <td>35</td> <td>6</td> <td>90</td> </tr> </tbody> </table>	No. of Males & Females	Not in Labor Force (in thousands)	Unemployed (in thousands)	Employed (in thousands)	Males	38	7	90	Females	35	6	90	
No. of Males & Females	Not in Labor Force (in thousands)	Unemployed (in thousands)	Employed (in thousands)												
Males	38	7	90												
Females	35	6	90												
		Estimates the total adult population and the total labor force in Pretoria.													
	(b)	From the above Table, calculate the unemployment rate and labor-force participation rate in Pretoria.	2												
	(c)	"Frictional Unemployment is inevitable". Analyze.	2												
8.	(a)	If the reserve ratio is 25% and the Central bank increases the quantity of reserve in the banking system by Rs. 120, find out by how much the money supply increases.	2												

	(b)	If Federal Reserves in USA increases discount rate from 2% to 4%, then analyze its impact on the money supply of USA.	2
	(c)	If the reserve ratio is 5% and money deposited with the bank is Rs. 1000. Calculate the money multiplier and supply of money in the economy?	2
9.	(a)	The following details are given relating to a hypothetical economy for the year 2023. $GDP = \$35000$, inflow of income from abroad = $\$10000$, Outflow of income to abroad = $\$7000$, Depreciation = $\$4000$. Calculate NDP and NNP.	2
	(b)	Claudia purchased a new motor car in 2020, paying \$90000 from New York, which was produced in San Francisco, USA. She sold the same car in 2022 to John at \$41,000. Analyze how these financial transactions affect the GDP of the USA in 2020 and 2022.	2
	(c)	In a hypothetical economy, the government spends \$30,000 on an old-age pension for the social security of the elderly people. Analyze its effect on the GDP of that economy.	2
10	(a)	The following details given relating to a hypothetical economy for the year 2021. Total adult population = 10,000, labour force participation rate = 90%. Unemployment rate = 10%. Compute number of persons unemployed.	2
	(b)	Calculate the unemployment rate of a country Y from the given data. Total Population = 80,000, Labour Force = 30,000 & No of Employed People = 20,000.	2
	(c)	<p>The Bureau of Labor Statistics announced that in January 2013, of all adult Americans, 143,322,000 were employed, 12,332,000 were unemployed, and 89,008,000 were not in the labor force. Use this information to calculate:</p> <ol style="list-style-type: none"> The adult population The labor force The labor-force participation rate The unemployment rate 	2

End of Questions