



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH

An Institute of National Importance under MoE

Saloh, Una - 177 209

Website: www.iitu.ac.in

AY 2023-24

School of Computing

Curriculum: IIITUGIT22

End Semester Exam

December 26, 2023

Degree	B.Tech.
Branch	IT
Semester	I
Subject code/name	MAC131/ Engineering Mathematics
Time	180 minutes
Maximum Marks	100

Answer all the questions.

Q. No.	Questions	Marks
1(a)	Solve the following system of equations using Gauss Elimination method: $\begin{aligned}y - z &= 3 \\ -2x + 4y - z &= 1 \\ -2x + 5y - 4z &= -2\end{aligned}$	5
1(b)	Examine if the system below is consistent: $\begin{aligned}x_1 + x_2 + 2x_3 + 2x_4 + x_5 &= 1 \\ 2x_1 + 2x_2 + 4x_3 + 4x_4 + 3x_5 &= 1 \\ 2x_1 + 2x_2 + 4x_3 + 4x_4 + 2x_5 &= 2 \\ 3x_1 + 5x_2 + 8x_3 + 6x_4 + 5x_5 &= 3\end{aligned}$	5
1(c)	Determine the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} -3 & 1 & -3 \\ 20 & 3 & 10 \\ 2 & -2 & 4 \end{bmatrix}$. Is the matrix A diagonalisable?	5
1(d)	Reduce the quadratic form $Q = 2x^2 + y^2 - 3z^2 - 8yz - 4zx + 12xy$ into canonical form and find its nature, rank, index and signature.	5
2(a)	Determine the radius and the interval of convergence of the power series $\sum_{n=0}^{\infty} 2^n (x-3)^n$.	5

2(b)	Examine if the series $\sum_{n=1}^{\infty} \left(\frac{1}{\ln(n+2)} - \frac{1}{\ln(n+1)} \right)$ is convergent.	5
2(c)	Show that the series $\sum_{n=1}^{\infty} \frac{(-1)^n(n+2)}{2^n+5}$ is absolutely convergent.	5
2(d)	If $\sum u_n$ is a positive terms convergent series, then show that the series $\sum u_n^2$ is also convergent. Is the converse true?	5
3(a)	Examine the function $f(x, y) = \begin{cases} \frac{x^2 - y^2}{x^2 + y^2}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ for continuity at origin.	5
3(b)	Given that $x = e^u + e^{-v}$, $y = e^{-u} - e^v$. Consider z is a function of x and y , prove that $\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x \frac{\partial z}{\partial x} - y \frac{\partial z}{\partial y}.$	5
3(c)	Sketch the region of integration and evaluate the integral: $\int_0^{\pi} \int_0^{\sin x} y \, dy \, dx$	5
3(d)	Investigate the function $f(x, y) = 6x^2 - 2x^3 + 3y^2 + 6xy$ for all the local maxima, local minima and saddle points.	5
4(a)	Determine if $W = \{(x_1, x_2, x_3) : x_1^2 + x_2^2 + x_3^2 \leq 1; x_1, x_2, x_3 \in \mathbb{R}\}$ is a subspace of \mathbb{R}^3 .	5
4(b)	Define spanning set for a vector space V . Determine if $(x, y, z) \in \mathbb{R}^3$, belongs to the span of $u_1 = (1, 1, 1)$, $u_2 = (1, 2, 3)$, $u_3 = (1, 5, 8)$.	5
4(c)	Examine whether the given set of vectors are linearly independent or dependent in \mathbb{R}^4 : $\{(1, 1, 1, 1), (1, 2, 3, 2), (2, 5, 6, 4), (2, 6, 8, 5)\}.$	5
4(d)	Find the dimension and a basis of the solution space W of the homogeneous system: $\begin{aligned} x + y + 2z &= 0 \\ 2x + 3y + 3z &= 0 \\ x + 3y &= 0 \end{aligned}$	5
5(a)	Let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ be a linear transformation defined by $T(x, y, z) = (x+z, x+y, x+y+z)$. Determine the matrix representation of T w.r.t. standard basis in \mathbb{R}^3 .	5
5(b)	Show that $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ defined by $T(x, y) = (x + 2y, 3x - y)$ is a linear transformation.	5
5(c)	Define range space of a linear transformation. Find the null space, rank and nullity of the linear transformation T defined in question 5(b).	5

5(d)

Consider the following two bases of $M_{2 \times 2}$

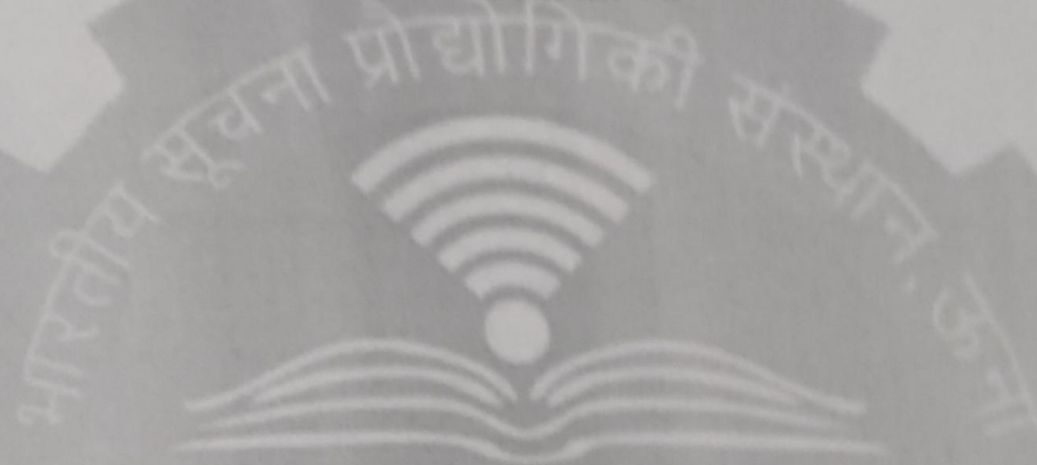
$$B_1 = \left\{ \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 \\ 1 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix} \right\}$$

and

$$B_2 = \left\{ \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}, \begin{bmatrix} 1 & -1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix} \right\}.$$

Find the transition matrices P and Q from basis B_1 to B_2 and B_2 to B_1 , respectively. State the relation between P and Q .

***** All the best*****





Indian Institute of Information Technology Una Himachal Pradesh

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AY 2023-24

School of Basic Sciences

CURRICULUM: IIITUGIT22

End Semester Examination

27, Dec.' 2023

Degree	B. Tech.	Branch	Information Technology
Semester	First		
Subject Code & Name	PHC132: Engineering Physics		
Time: 180 Minutes	Answer All Questions	Maximum: 100 Marks	

Sl. No.	Question	Marks
1.a	Explain the following terms with examples: i) Inertial frame of reference. ii) Non-inertial frame of reference.	2.5 + 2.5
1.b	For the L-C oscillator circuit: i) Make use of Lagrange's formulation, and find the equation of motion. ii) Make use of Hamilton's formulation, and find the equation of motion.	2.5 + 2.5
1.c	An observer detects two explosions that occur at the same time, one near by the observer and the other 100Km away. Another observer finds that the two explosions occur 160Km apart. What time interval separates the explosions to the second observer?	5
1.d	Make use of special theory of relativity, and show that the acceleration of a particle of mass 'm' and velocity 'v' when it is acted upon by the constant force F, where F is parallel to v, is given by $a = \frac{F}{m} \left(1 - \frac{v^2}{c^2}\right)^{\frac{3}{2}}$	5
2.a	Compare the energy loss of a photon in the following situation: i) One single Compton scattering through 180°, ii) Two single Compton scattering through 90°.	2.5 + 2.5
2.b	Show that the wave functions $\psi_1(x) = Ae^{-\frac{x^2}{a^2}}$ and $\psi_2(x) = Bxe^{-\frac{x^2}{a^2}}$ are orthogonal to each other.	5
2.c	A particle of mass m_e trapped in an infinite depth well of width of 1.0nm. Consider the transition from the first excited state to the ground state. Calculate the wavelength of light emitted. In which region of electromagnetic spectrum does it fall?	5
2.d	Make use of commutator algebra, and show that: $[\hat{J}_x, [\hat{J}_y, \hat{J}_z]] + [\hat{J}_y, [\hat{J}_z, \hat{J}_x]] + [\hat{J}_z, [\hat{J}_x, \hat{J}_y]] = 0.$	5

3.a	Compare the relative probabilities of spontaneous and stimulated emission in an equilibrium system at room temperature ($T = 350\text{K}$) for transitions that occur in the visible ($h\nu = 2.5\text{eV}$) and the microwave regions ($h\nu = 10^{-5}\text{eV}$) of the spectrum.	5
3.b	Explain the following single-qubit, and multi-qubit quantum gates: i) Hadamard (H), ii) CCNOT.	2.5 + 2.5
3.c	The phase velocity for deep water waves is given by: $v_p = \sqrt{\left(\frac{g}{k} + \frac{Sk}{\rho}\right)},$ Show that the phase velocity is minimum at $\lambda = 2\pi\sqrt{\frac{s}{\rho g}}$.	5
3.d	Explain the following terms: i) Quantum Superposition. ii) Quantum Entanglement.	2.5 + 2.5
4.a	The Hall coefficient and electrical conductivity of silicon are $-7.2 \times 10^{-5}\text{ m}^3/\text{C}$ and $1.5 \times 10^8\text{ mho/m}$, respectively. i) Calculate the magnitude of the mobility of the electrons. ii) How many charge carriers are there in the silicon sample? iii) What is the type of semiconductor?	2 + 2 + 1
4.b	Make a table of five key differences among Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistical distributions.	5
4.c	Explain the BH hysteresis curve of the following magnetic materials: i) Ferromagnetic. ii) Paramagnetic.	2.5 + 2.5
4.d	Make use of superconductivity, and explain the following: i) DC Josephson effect. ii) AC Josephson effect.	2.5 + 2.5
5.a	In a cubic unit cell, find the angle between normals to the planes of Miller indices (111) and (121).	5
5.b	What is the Fermat's principle of extremum path? Make use of optical path, and verify the law of refraction.	2 + 3
5.c	Build the structure of an optical fiber cable layer by layer with technical details, and explain the optical fiber communication setup.	2.5 + 2.5
5.d	Consider a step index fiber for which the refractive indices of core and cladding medium are $\mu_1 = 1.475$, and $\mu_2 = 1.460$ respectively. Find the maximum value of acceptance angle, and V-number, while the core diameter is $25\mu\text{m}$.	5

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School of Basic Sciences

CURRICULUM: IIITUGIT22

End Semester Examination

28, Dec.'23

Degree	B. Tech.	Branch	IT
Semester	I		
Subject Code & Name	BIC103: Introduction to Biotechnology		
Time: 180 Minutes	Answer All Questions		Maximum: 100 Marks

S. No.	Question	Marks
1.a	(i) Calculate the magnification power of a light microscope when the plant cell is viewed using the 10X objective lens and 100X objective lens, respectively. (ii) Calculate the chlorophyll content of two plant leaves showing the absorbance values of A_{650} are 0.4 and 0.5, respectively. (iii) Calculate the number of peptide bonds present in myoglobin protein comprised of 153 amino acids.	(2+2+1=5)
1.b	(i) Human DNA contains 30% guanine on a molar basis. What are the mole percentages of adenine, cytosine, and thymine? (ii) Identify the bacterial cell from a mixture of three types of cells namely plant, animal, and bacteria based on structural differences. (iii) The start of the coding region for the human globin gene reads 5'-ATGGTGCAC-3'. What is the sequence of the complementary strand for this segment of DNA?	(2+2+1=5)
1.c	(i) Determine the amino acid sequence pattern of the peptide after the treatments of trypsin and cyanogen bromide to the given peptide Met-Gly-Ser-Met-Ala-Lys-Ala-Leu-Ser-Ala-Met-Ser-Ala-Pro. (ii) Solve the code of mRNA sequence for amino acids pattern as follows: 5'-AUGGAGAGCUAUCAUCCACCACCAGUGAUCCUGUAA-3' What would happen to the peptide sequence when the twelfth nucleotide of the mRNA, an uracil residue, is mutated by replacing it with an adenine residue?	(2.5+2.5=5)
1.d	Model the block diagram for DNA replication and associated protein role in the semi-conservative replication.	(5)
2.a	Outline the working of Next Generation Sequencing technology employed for generating the massive biological data with a suitable example.	(5)
2.b	Model the block diagram of the amplification process of a target gene using polymerase chain reaction.	(5)
2.c	Construct the process of DNA libraries and screen to identify cloned genes of interest.	(5)

- 2.d (i) Draw the separation pattern of three DNA fragments of 200 bp, 250 bp, and 300 bp using agarose gel electrophoresis. (2.5+2.5=5)
 (ii) Find out the protein separation pattern of three different sizes of 25 kDa, 50 kDa, and 75 kDa using the size exclusion chromatography.

3.a Demonstrate the working mechanism of four different of vaccines with suitable examples. (5)

3.b Outline the protoplast fusion technology and regeneration of a hybrid plant with a commercial example. (5)

- 3.c (i) Calculate the isoelectric point (pI) of an amino acid arginine if the data of pK_1 , pK_2 , and pK_R are 2.17, 9.04, and 12.48 respectively. Interpret the significance of the obtained pI data pertaining to protein structure. (3+2=5)
 (ii) Calculate the specific activity, and yield (%) of a target protein for each step from the given purification data as follows:

Purification step	Total Protein (mg)	Total Activity (U)	Specific Activity	Yield %
A	5000	15000		
B	1000	7500		

3.d Examine the process of fusion protein design and its application to isolate a recombinant protein of interest. (5)

4.a Illustrate the process of nuclear reprogramming of somatic cells to produce induced pluripotent stem cells. (5)

4.b Draw the DNA fingerprinting pattern of the identical twins, non-identical twins and recombinant DNA copies. (5)

4.c Examine the unit operations processes employed in the wastewater treatment. (5)

4.d Make use of aerobic and anaerobic mechanism of biodegradation of waste materials with special reference to man-made pollutants. (5)

5.a What types of biological databases can be used in bioinformatics? Enlist the molecular data formats and their visualization tools. (5)

- 5.b (i) Explain how do patents protect drugs and devices? (2+ 3=5)
 (ii) Summarize the two leading bioethics approaches with suitable examples.

5.c Apply the bioethics approaches on the following situation: Biopharma company develops a vaccine for a deadly disease without the complete validation of 12 years of drug discovery regulatory check but early studies show that the vaccine is effective in only about 60% of patients, should the biopharma company wait to bring the vaccine to market while they work to improve its efficacy and people suffering from the disease die, or should it be available immediately. (5)

5.d Make use of the Food Drug and Administration regulatory body in quality check of the biopharma products, particularly to the drug phase testing. (5)

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School of Computing

CURRICULUM: IITUGIT22

End Semester Examination

29, Dec'23

Degree	B. Tech.	Branch	IT
Semester	I		
Subject Code & Name	ITC104 / Basics of Programming in C		
Time: 60 Minutes	Answer All Questions	Maximum: 100 Marks	

S. N.	Question	Marks
1.a	Differentiate between structure and union data types with proper examples. Also write down any four differences between array and structure.	5(3+2)
1.b	What is meant by operator associativity and the precedence rule in C. Also, discuss the output in the following program code: <pre>#include <stdio.h> void main() { int k = 10, out; out = k++ + ++k; printf("%d %d", out, k); }</pre>	5(2+3)
1.c	i. Can an array be declared without specifying its size or can the fixed size of an array be changed at runtime in C? Explain with the help of an example. ii. Which dimension is necessarily to be specified while declaring a two dimensional array and why?	5(2.5+2.5)
1.d	Explain briefly the following: i. continue statement ii. goto statement iii. break statement iv. typedef v. enumerated data type	5
2.a	Explain the enumerated data type in C and also implement it. Identify and explain the type of error in the following codes (if any). Also, mention its output: i. <pre>#include <stdio.h> enum mobile{Samsung=1, Motorola, Apple, Blackberry, Nokia=4, Vivo, Oppo}; int main() {</pre>	5(1+2+2)

	<pre>enum mobile c; c=Blackberry; printf("The value of c is %d",c); return 0; }</pre> <p>ii. #include <stdio.h></p> <pre>enum Yenum{C, CPP, Java}; enum Xenum{C, CPP, Python, Yenum}; int main() { enum Xenum var; printf("%d",sizeof(var)); return 0; }</pre>	
2.b	<p>Discuss the total memory space that is required in the following C declaration:</p> <pre>struct { int s[5]; union { float y; long z; }p; }q;</pre> <p>Assume that objects of the type int, float, and long occupy 2 bytes, 4 bytes, and 8 bytes, respectively. Ignore the memory requirement for variables p and q.</p>	5
2.c	What is an operator? Explain the arithmetic, relational, logical, and assignment operators in C language	5(1+4)
2.d	<p>Explain the following:</p> <ol style="list-style-type: none"> gets() vs scanf() function puts() vs printf() function getch() function fprintf() function pow() function 	5
3.a	What are library functions? Explain any four library functions in C (functions available in string.h).	5(1+4)
3.b	Define Recursion. Write a C program to print first n terms of Fibonacci series using recursion.	5(1+4)
3.c	<p>What is the meaning of storage class? Discuss its significance. Also, write and explain the output of the following code:</p> <pre>void fun() { static int n; printf("%d ", n); n--; }</pre>	5(2+3)

	<pre> int main() { int k=0; while(k < 5) { fun(); k++; } } </pre>	
3.d	<p>How does a pointer access a value that is stored at some other location? Also, analyze the following code and determine its output:</p> <pre> #include <stdio.h> int main() { float value = 0.7; float *p = &value; if (*p < 0.7) printf("Good Day"); else printf("Beautiful Day"); } </pre>	5(2+3)
4.a	<p>Define string. Write a program to print the reverse of a string with the help of a user defined function.</p>	5(1+4)
4.b	<p>Write a program to print the sum of principal diagonal elements and product of secondary diagonal elements of a matrix.</p>	5
4.c	<p>Write and explain the output of the following codes:</p> <p>i. <pre> #include <stdio.h> void main() { int arr[] = {10, 20, 30}; int *p = arr; ++*p; printf("arr[0] = %d, arr[1] = %d, *p = %d", arr[0], arr[1], *p); } </pre></p> <p>ii. <pre> #include<stdio.h> int main() { int x=55; printf("%d, %d, %d\n", x<=55, x=40, x>=10); return 0; } </pre></p>	5(2.5+2.5)
4.d	<p>Discuss the concept of dynamic memory allocation in C and explain the purpose of following functions:</p> <ol style="list-style-type: none"> malloc() function calloc() function realloc() function free() function 	5(1+4)

5.a	Differentiate between call by value and call by reference. Write a C program to swap values of two variables using both methods.	5
5.b	<p>Identify and explain the type of error in the following codes (if any). Also, mention its output:</p> <p>i. <code>#include <stdio.h></code> <code>int main(){</code> <code>int i, j, count;</code> <code>count=0;</code> <code>for(i=0; i<5; i++);</code> <code>{</code> <code>for(j=0; j<5; j++);</code> <code>{</code> <code>count++;</code> <code>}</code> <code>}</code> <code>printf("%d", count);</code> <code>return 0;</code> <code>}</code></p> <p>ii. <code>#include<stdio.h></code> <code>int main(){</code> <code>int x=4, y, z;</code> <code>y = --x;</code> <code>z = x--;</code> <code>printf("%d, %d, %d\n", x, y, z);</code> <code>return 0;</code> <code>}</code></p>	5(2.5+2.5)
5.c	What is the role of dot (.) operator and arrow (->) operator in structure? Explain with an example.	5(2+3)
5.d	<p>Explain the following:</p> <p>i. Macros</p> <p>ii. Array bound checking</p> <p>iii. Compiler and Interpreter</p> <p>iv. Algorithm and Pseudocode</p> <p>v. Array of structure</p>	5

*****All the Best*****