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PROGRAMMING IN C **Course Code : 312303**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Second**
Course Title	**: PROGRAMMING IN C**
Course Code	**: 312303**

I. RATIONALE

'C' programming language helps to build a strong foundation for computer programming. This course will help to solve beginner level problems such as mathematical operations, string processing, data structure and data structure related processing, with the help of basic concepts, control flow structures, and principles of C. This course is basically designed to create a base to develop foundation skills of procedure - oriented programming.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Develop 'C' programs that address issues with processing strings, mathematic operations, and data structures.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Develop C program using input - output functions and arithmetic expressions
- CO2 - Develop C program involving branching and looping statements
- CO3 - Implement Arrays and structures using C programs
- CO4 - Develop C program using user-defined functions
- CO5 - Write C program using pointer

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
312303	PROGRAMMING IN C	PIC	AEC	4	1	4	1	10	5	3	30	70	100	40	50	20	50#	20	25	10	225

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Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Write algorithm for given problem statement. TLO 1.2 Identify the given building blocks of a C Program. TLO 1.3 Use basic constructs like constants, variables, data types for developing C program. TLO 1.4 Write C programs using printf() and scanf() functions. TLO 1.5 Write C programs using arithmetic operators, bitwise operators.	**Unit - I Basics of 'C' Programming** 1.1 Fundamentals of algorithms: Notion of algorithm, Notations used for assignment statements and basic control structures. 1.2 Introduction to 'C': General structure of ' C' program, Header file, 'main ()' function. 1.3 Fundamental constructs of 'C': Character set, tokens, keywords, Identifiers, Constants - number constants, character constants, string constants, Variables. Data types in 'C': Declaring variables, data type conversion. 1.4 Basic Input and Output functions: input and output statements using printf(), scanf() functions. 1.5 Assignments and expressions: simple assignment statements, arithmetic operators, shift operators, bitwise operators, sizeof operator.	Chalk-Board Demonstration Hands-on
2	TLO 2.1 Write a 'C' program using decision making statements. TLO 2.2 Use loop statements in C program to solve iterative problems. TLO 2.3 Use appropriate statement to alter the program flow in the loop.	**Unit - II Control structures** 2.1 Conditional statements: Relational operators, logical operators, if statement, if-else statements, nested if-else statements, if-else ladder, switch statement. 2.2 Looping statements : 2.1 while loop, do… while loop, for loop. 2.3 Branching Statements: goto statement, use of 'break' and 'continue' statements.	Chalk-Board Demonstration Presentations Hands-on

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Write a C Program to perform operations on one dimensional array. TLO 3.2 Declare, initialize, and access elements of two dimensional array. TLO 3.3 Declare ,initialize and access data using Structure. TLO 3.4 Explain typedef and enum	**Unit - III Arrays and structure** 3.1 Characteristics of an array, One dimension and two dimensional arrays, concept of multi-dimensional arrays. 3.2 Array declaration and Initialization. 3.3 Operations on Arrays. 3.4 Character and String input/output and String related operations. 3.5 Introduction and Features of Structures, Declaration and Initialization of Structures, array of structures. 3.6 Type def, Enumerated Data Type.	Chalk-Board Demonstration Hands-on Video Demonstrations
4	TLO 4.1 Explain need of Functions in C program. TLO 4.2 Write C Program involving C library functions. TLO 4.3 Write user defined functions for given problem in C program. TLO 4.4 Write C Program for calling function by ‘value’ and calling function by ‘reference’. TLO 4.5 Implement recursive functions in C Program.	**Unit - IV Functions** 4.1 Concept and need of functions. 4.2 Library functions: Math functions, String handling functions, other miscellaneous functions such as getchar(), putchar(), malloc(), calloc(). 4.3 Writing User defined functions - function definition, functions declaration, function call, scope of variables - local variables, global variables. 4.4 Function parameters: Parameter passing- call by value & call by reference, function return values, function return types ,declaring function return types, The 'return' statement. 4.5 Recursive functions.	Chalk-Board Demonstration Presentations Hands-on
5	TLO 5.1 Declare and Define Pointer Variable. TLO 5.2 Write C program to print the address and values of pointer variables. TLO 5.3 Write C program to perform arithmetic operations using pointers. TLO 5.4 Write C Program to perform operations on Arrays using Pointers. TLO 5.5 Explain string related operations using pointer. TLO 5.6 Access individual variable of structure using Pointer.	**Unit - V Pointers** 5.1 Introduction to Pointers : Definition, use of pointers, ‘*’ and ‘&’ operators, declaring, initializing, accessing pointers. 5.2 Pointer arithmetic. 5.3 Pointer to array. 5.4 Pointer and Text string. 5.5 Function handling using pointers. 5.6 Pointers to structure.	Demonstration Chalk-Board Presentations Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

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<table>
<tr><th>Practical / Tutorial / Laboratory Learning Outcome (LLO)</th><th>Sr No</th><th>Laboratory Experiment / Practical Titles / Tutorial Titles</th><th>Number of hrs.</th><th>Relevant COs</th></tr>
<tr><td>LLO 1.1 Write logical steps for given program flow
LLO 1.2 Write the standard English like statements for programming flow of given problem statement</td><td>1</td><td>* Install and study the C programming environment</td><td>2</td><td>CO1</td></tr>
<tr><td>LLO 2.1 Write Simple C program using constant and variables
LLO 2.2 Use the arithmetic operators for developing C Program</td><td>2</td><td>Implement C programs using Constants and Variables</td><td>2</td><td>CO1</td></tr>
<tr><td>LLO 3.1 Use Arithmetic operators in C Program</td><td>3</td><td>* Implement C programs using arithmetic operators to solve given arithmetic operations</td><td>2</td><td>CO1</td></tr>
<tr><td>LLO 4.1 Write code for type casting in C</td><td>4</td><td>Implement C programs using implicit and Explicit data type conversion</td><td>2</td><td>CO1</td></tr>
<tr><td>LLO 5.1 Write C code for displaying formatted output with comments wherever applicable.</td><td>5</td><td>* Write well commented C programs using formatted Input/Output statements.

e.g. Sample Output:
<table><tr><td>Name</td><td>:</td><td>FName MName Lname</td></tr><tr><td>Roll No</td><td>:</td><td>XXXX</td></tr><tr><td>Percentage</td><td>:</td><td>(upto 2 decimal places)</td></tr><tr><td>Date of Birth</td><td>:</td><td>DD/MM/YYYY</td></tr><tr><td>Branch, College</td><td>:</td><td>XXXXXXXXXXXX</td></tr></table></td><td>4</td><td>CO1</td></tr>
<tr><td>LLO 6.1 Use Relational and logical operators in C to solve given problem
LLO 6.2 Write C program using Relational and logical operators for solving given problem</td><td>6</td><td>* Implement minimum two C programs using Relational and conditional operator.</td><td>2</td><td>CO1
CO2</td></tr>
<tr><td>LLO 7.1 Use logical operators in given expressions</td><td>7</td><td>* Implement minimum two C programs using Logical Operators</td><td>2</td><td>CO1
CO2</td></tr>
<tr><td>LLO 8.1 Write expressions using bitwise operators in given problem statement</td><td>8</td><td>Implement minimum two C programs using Bitwise Operators</td><td>2</td><td>CO1
CO2</td></tr>
<tr><td>LLO 9.1 Write the syntax for various if statements
LLO 9.2 Write C program for any problem using If statements</td><td>9</td><td>Implement minimum two C programs using simple If statement and if..else statement.</td><td>2</td><td>CO2</td></tr>
</table>

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Write syntax of if.. else statements	10	* Implement minimum two C programs using nested If ..else statement and if.. else if ladder e.g.- Write and Execute the C program to print the grades of students based on percentage. Grade: Distinction If per>=75 Grade: A If per>=60 and Per<75 Grade: B If per>=55 and Per<60 Grade: Pass If per>=40 and Per<55 Grade:Fail if per<40	4	CO2
LLO 11.1 Write syntax of Switch statement to solving given problem	11	* Develop C program using Switch staements	2	CO2
LLO 12.1 Write C program using Switch statement.	12	* Write a C program to print English Calendar months as per given number(eg: If input is 4 then print “April”) using Switch statement	2	CO2
LLO 13.1 Implement iterative solution to problem using while and do - - while loop	13	* Implement minimum two C programs using 'while' loop and 'do...while' loop statements.	2	CO2
LLO 14.1 Write the syntax for statement. LLO 14.2 Write C code for solving given problem using for loop.	14	Implement C programs using for loop statement (e.g.- Write a C Program to print numbers from 1 to 100)	2	CO1 CO2
LLO 15.1 Write syntax for while and do ... while loop LLO 15.2 Write syntax for 'for' loop	15	* Print various patterns using loops. e.g. - Write C Program to print following or similar pattern * * * * * * * * * *	2	CO2
LLO 16.1 Declare and initialize the Array. LLO 16.2 Write C program for implementation of one dimensional array.	16	* Implement C programs using One Dimensional Array. (e.g.-Write C program to input 5 numbers using array and display sum of it)	2	CO2 CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 17.1 Declare and initialize two dimensional Array. LLO 17.2 Write C program for implementation of two dimensional array.	17	* Implement C programs using Two Dimensional Array. (e.g.-Write C program to calculate addition of two 3X3 matrices.)	4	CO3
LLO 18.1 Declare character array as Strings in C LLO 18.2 Write C programs for print string operations without using string handling functions	18	* Write C program to perform following operations without using standard string functions. i) Calculate Length of given string ii) Print reverse of given string.	2	CO3
LLO 19.1 Declare ,define and access structure variables	19	Implement 'Structure' in C (e.g. - Add and Substract complex numbers using structure)	4	CO3
LLO 20.1 Write C programs using Array of Structure	20	* Implement ' Array of Structure' in C (e.g.-Accept and Display 10 Employee information using structure)	2	CO3
LLO 21.1 Use built-in library functions in C programs	21	* Develop C program using in-built mathematical and string functions.	2	CO4
LLO 22.1 Write C programs using user defined functions	22	* Write C program to demonstrate User defined Functions	4	CO4
LLO 23.1 Write Recursive functions in C.	23	Implement recursive functions in C program.	2	CO4
LLO 24.1 Declare and initialize pointer variables LLO 24.2 Write C program to access variables using pointers.	24	* Write C Program to print addresses and values of variables using Pointer. (e.g.- Write C program to access and display address of variables.)	2	CO5
LLO 25.1 Perform arithmetic operations using pointers.	25	* Implement C Programs to perform arithmetic operations using Pointer.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Self learning

- 1.Complete any one course related to Programming in C on Infosys Springboard

2.Develop C language code for relevant topics suggested by the teacher

Assignment

- 1.Solve an assignment on any relevant topic given by the teacher

Micro project

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- The micro project has to be Industry Application Based, Internet-based, Workshop-based, Laboratory-based or Field-based as suggested by Teacher

1. Prepare a simple calculator to perform mathematical operations. Accept values and operations to be performed from user. Allow only numeric values else show appropriate messages to user.
2. Prepare menu driven program for Invoice management system. Accept user inputs and generate receipt and calculate amounts as per purchased items.
3. Develop employee leave management system to display leave related information of employee.
4. Develop food menu card for restaurant. Display food items. Accept food menu, quantity and generate bill for the same.
5. Develop a menu-driven program to perform matrix operations - matrix addition, matrix multiplication, transpose of matrix .

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	1 Computer system - (Any computer system with basic configuration)	All
2	2 ‘C’ Compiler (Any)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of ‘C’ Programming	CO1	10	4	2	6	12
2	II	Control structures	CO1,CO2	14	4	4	8	16
3	III	Arrays and structure	CO3	12	4	4	8	16
4	IV	Functions	CO4	12	2	4	8	14
5	V	Pointers	CO5	12	2	2	8	12
Grand Total				**60**	**16**	**16**	**38**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators
- Each practical will be assessed considering

60% weightage to process
40% weightage to product

- A continuous assessment based term work

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Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	1	-	-	1			
CO2	2	3	3	2	-	-	2			
CO3	2	3	3	3	-	2	2			
CO4	1	3	3	3	1	2	3			
CO5	1	3	3	3	1	1	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	E. Balaguruswamy	Programming in ANSI 'C'	Mcgraw Hill Publications ISBN 0070534772
2	Yashwant Kanetkar	Let us 'C'	BPB Publication ISBN 9788183331630
3	David Griffiths, Dawn Griffiths	Head First C	O'Reilly Media, Inc. ISBN: 9781449345013

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://nptel.ac.in/courses/106104128	C Programming
2	https://jsommers.github.io/cbook/control.html	Control structures, flow control statements in C
3	https://www.learn-c.org/en/Functions	Functions
4	https://www.simplilearn.com/tutorials/c-tutorial/pointers-in-c	Pointers
5	https://www.w3schools.com/c/	C Programming
6	https://www.javatpoint.com/c-programming-language-tutorial	C Programming tutorial
7	https://www.programiz.com/c-programming	C Programming
8	https://www.programiz.com/c-programming/online-compiler/	online C compiler

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

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MSBTE Approval Dt. 01/10/2024 **Semester - 2, K Scheme**