B.Tech First Year Syllabus

(BATCH 2026)

B.Tech Biotech Engineering

Semester I	B.Tech Biotech Engineering												w.e.f 2026-2030 Batch
S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	PDCC-A101	Professional Communication	AEC	HSMC	2	2	0	0	2	30	25	25	50	100
2	TPH101	Engineering Physics	DSC	BSC	3	3	0	0	3	45	25	25	50	100
3	TMA103	Engineering Mathematics	DSC	BSC	3	2	1	0	3	45	25	25	50	100
4	TBT 103	Introduction to Bioengineering	SEC	BSC	3	3	0	0	3	45	25	25	50	100
5	TCS101	Fundamental of Computer & Introduction to Programming	DSC	ESC	3	3	0	0	3	45	25	25	50	100
6	HSMC101	Design Thinking	VAC	ESC	1	0	0	2	2	15	25	25	50	100
7	PBT 102	Bioengineering Lab	SEC	LC	1	0	0	2	2	15	25	25	50	100
8	PPH151	Physics Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
9	PCS151	Computer Lab-I	DSC	LC	2	0	0	4	4	30	25	25	50	100
				Total	**19**	**13**	**1**	**10**	**24**	**285**	**225**	**225**	**450**	**900**
MNG Course														
1	THF101	Healthy Living & Fitness	VAC	MNG	2	2	0	0	2	30	Qualified/ NoN Qualified			

Semester II	B.Tech B.Tech Biotech Engineering												w.e.f 2026-2030 Batch
S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	TCS 204	Computational Thinking	DSC	ESC	3	3	0	0	3	45	25	25	50	100
2	TCH202	Chemistry for Biotechnology	DSC	BSC	3	3	0	0	3	45	25	25	50	100
3	TBT202	Medical Biotechnology and Healthcare Applications	SEC	BSC	3	2	1	0	3	45	25	25	50	100
4	TCS201	Programing for Problem Solving	DSC	ESC	3	3	0	0	2	45	25	25	50	100
5	EEC201	Basic Electrical and Electronics Engineering	DSC	ESC	4	3	1	0	4	60	25	25	50	100
6	PCS 254	Python Programming Lab	DSC	LC	2	0	0	4	4	30	25	25	50	100
7	PCH252	Chemistry for Biotechnology Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
8	PME253	Engineering Graphics and Design Lab	SEC	LC	2	0	0	4	4	30	25	25	50	100
9	PCS251	Computer Lab - II	DSC	LC	2	0	0	4	4	30	25	25	50	100
10	EEC251	Basic Electrical and Electronics Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
11	GP201	General Proficiency-I	SEC	SEC	1	-	-	-	-	15	100	-	-	100
				Total	**25**	**14**	**2**	**16**	**31**	**375**	**350**	**250**	**500**	**1100**
MNG Course														
1	**TEV 201**	**Environmental Science**	**VAC**	**MNG**	**2**	**2**	**0**	**0**	**2**	**30**	**Qualified/ NoN Qualified**			

B.Tech CE, ME (Including all specialization) and Aerospace Engineering

Electrical Group	B.Tech CE, ME (Including all specialization) and Aerospace Engineering												w.e.f 2026-30 Batch
S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	PDCC-A101/201	Professional Communication	AEC	HSMC	2	2	0	0	2	30	25	25	50	100
2	TPH101/201	Engineering Physics	DSC	BSC	3	3	0	0	3	45	25	25	50	100
3	TMA101	Engineering Mathematics-I	DSC	BSC	3	2	1	0	3	45	25	25	50	100
4	TEE101/201	Basic Electrical Engineering	DSC	ESC	2	2	0	0	2	30	25	25	50	100
5	TCS101	Fundamental of Computer & Introduction to Programming	DSC	ESC	3	3	0	0	3	45	25	25	50	100
6	HSMC101/201	Design Thinking	VAC	ESC	1	0	0	2	2	15	25	25	50	100
7	PEE151/251	Basic Electrical Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
8	PPH151/251	Physics Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
9	PME151/251	Workshop And Manufacturing Practices	SEC	LC	2	0	0	4	4	30	25	25	50	100
10	PCS151	Computer Lab-I	DSC	LC	2	0	0	4	4	30	25	25	50	100
				Total	20	12	1	14	27	300	250	250	500	1000
MNG Course														
1	THF101/201	Healthy Living & Fitness	VAC	MNG	2	2	0	0	2	30	Qualified/ NoN Qualified			

Electronics Group	B.Tech CE, ME (Including all specialization) and Aerospace Engineering												w.e.f 2026-30 Batch
S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	TCS104/204	Computational Thinking	DSC	ESC	3	3	0	0	3	45	25	25	50	100
2	TCH101/201	Engineering Chemistry	DSC	BSC	3	3	0	0	3	45	25	25	50	100
3	TMA201	Engineering Mathematics-II	DSC	BSC	3	2	1	0	3	45	25	25	50	100
4	TCS201	Programming for Problem Solving	DSC	ESC	3	3	0	0	3	45	25	25	50	100
5	TEC101/201	Basic Electronics Engineering	DSC	ESC	2	2	0	0	2	30	25	25	50	100
6	PCH151/251	Chemistry Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
7	PME153/253	Engineering Graphics and Design Lab	SEC	LC	2	0	0	4	4	30	25	25	50	100
8	PCS251	Computer Lab - II	DSC	LC	2	0	0	4	4	30	25	25	50	100
9	PEC151/251	Basic Electronics Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
10	PCE151/251	Basic Civil Engg Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
11	PCS154/254	Python Programming Lab	DSC	LC	2	0	0	4	4	30	25	25	50	100
12	GP201	General Proficiency-I	SEC	SEC	1	-	-	-	-	15	100	-	-	100
				Total	24	13	1	18	32	360	375	275	550	1200
MNG Course														
1	TEV101/201	Environmental Science	VAC	MNG	2	2	0	0	2	30	Qualified/ NoN Qualified			

B.Tech AI ML & AI DS Branch

Semester I		B.Tech AI ML & AI DS Branch												w.e.f 2026-30 Batch
S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	TCS104	Computational Thinking	DSC	ESC	3	3	0	0	3	45	25	25	50	100
2	TMA102	Mathematics for AI-I	DSC	BSC	3	2	1	0	3	45	25	25	50	100
3	TCS101	Fundamental of Computer & Introduction to Programming	DSC	ESC	3	3	0	0	3	45	25	25	50	100
4	TEC101	Basic Electronics Engineering	DSC	ESC	2	2	0	0	2	30	25	25	50	100
5	PME153	Engineering Graphics and Design Lab	SEC	LC	2	0	0	4	4	30	25	25	50	100
6	PCS151	Computer Lab-I	DSC	LC	2	0	0	4	4	30	25	25	50	100
7	PCS154	Python Programming Lab	DSC	LC	2	0	0	4	4	30	25	25	50	100
8	PEC151	Basic Electronics Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
9	PCE151	Basic Civil Engg Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
				Total	**19**	**10**	**1**	**16**	**27**	**285**	**225**	**225**	**450**	**900**
MNG Course														
1	**TEV101/201**	**Environmental Science**	**VAC**	**MNG**	**2**	**2**	**0**	**0**	**2**	**30**	Qualified/ NoN Qualified			

Semester II		B.Tech AI ML & AI DS Branch												w.e.f 2026-30 Batch
S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	PDCC-A201	Professional Communication	AEC	HSMC	2	2	0	0	2	30	25	25	50	100
2	TPH201	Engineering Physics	DSC	BSC	3	3	0	0	3	45	25	25	50	100
3	TMA203	Mathematics for AI-II	DSC	BSC	3	2	1	0	3	45	25	25	50	100
4	TEE201	Basic Electrical Engineering	DSC	ESC	2	2	0	0	2	30	25	25	50	100
5	TCS203	Fundamental of AI and ML	DSC	PCC	3	3	0	0	3	45	25	25	50	100
6	TCS201	Programming for Problem Solving	DSC	ESC	3	3	0	0	3	45	25	25	50	100
7	HSMC201	Design Thinking	VAC	ESC	1	0	0	2	2	15	25	25	50	100
8	PEE251	Basic Electrical Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
9	PPH251	Physics Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
10	PME251	Workshop And Manufacturing Practices	SEC	LC	2	0	0	4	4	30	25	25	50	100
11	PCS253	AI and ML Lab using Python	DSC	LC	1	0	0	2	2	15	25	25	50	100
12	PCS251	Computer Lab - II	DSC	LC	2	0	0	4	4	30	25	25	50	100
13	GP201	General Proficiency-I	SEC	SEC	1	-	-	-	-	15	100	-	-	100
				Total	**25**	**15**	**1**	**16**	**32**	**375**	**400**	**300**	**600**	**1300**
MNG Course														
1	THF101/201	Healthy Living & Fitness	VAC	MNG	2	2	0	0	2	30	Qualified/ NoN Qualified			

B.Tech- CSE, ECE and EE (With all specialization)

Electrical Group	B.Tech- CSE, ECE and EE (With all specialization)	w.e.f 2026-30 Batch

S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	PDCC-A101/201	Professional Communication	AEC	HSMC	2	2	0	0	2	30	25	25	50	100
2	TPH101/201	Engineering Physics	DSC	BSC	3	3	0	0	3	45	25	25	50	100
3	TMA101/**TMA102	Engineering Mathematics-I/** Mathematics for AI-I	DSC	BSC	3	2	1	0	3	45	25	25	50	100
4	TEE101/201	Basic Electrical Engineering	DSC	ESC	2	2	0	0	2	30	25	25	50	100
5	TCS101	Fundamental of Computer & Introduction to Programming	DSC	ESC	3	3	0	0	3	45	25	25	50	100
6	HSMC101/201	Design Thinking	VAC	ESC	1	0	0	2	2	15	25	25	50	100
7	PEE151/251	Basic Electrical Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
8	PPH151/251	Physics Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
9	PME151/251	Workshop And Manufacturing Practices	SEC	LC	2	0	0	4	4	30	25	25	50	100
10	PCS151	Computer Lab-I	DSC	LC	2	0	0	4	4	30	25	25	50	100
				Total	**20**	**12**	**1**	**14**	**27**	**300**	**250**	**250**	**500**	**1000**

MNG Course

1	THF101/201	Healthy Living & Fitness	VAC	MNG	2	2	0	0	2	30	Qualified/ NoN Qualified	

Electronics Group	B.Tech- CSE, ECE and EE (With all specialization)	w.e.f 2026-30 Batch

S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	TCS104/204	Computational Thinking	DSC	ESC	3	3	0	0	3	45	25	25	50	100
2	TMA201/** TMA203	Engineering Mathematics-II/** Mathematics for AI-II	DSC	BSC	3	2	1	0	3	45	25	25	50	100
3	TCS201	Programming for Problem Solving	DSC	ESC	3	3	0	0	3	45	25	25	50	100
4	TEC101/201	Basic Electronics Engineering	DSC	ESC	2	2	0	0	2	30	25	25	50	100
5	PCS154/254	Python Programming Lab	DSC	LC	2	0	0	4	4	30	25	25	50	100
6	PME153/253	Engineering Graphics and Design Lab	SEC	LC	2	0	0	4	4	30	25	25	50	100
7	PCS251	Computer Lab - II	DSC	LC	2	0	0	4	4	30	25	25	50	100
8	PEC151/251	Basic Electronics Engineering Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
9	PCE151/251	Basic Civil Engg Lab	DSC	LC	1	0	0	2	2	15	25	25	50	100
10	GP201	General Proficiency-I	SEC	SEC	1	-	-	-	-	15	100	-	-	100
				Total	**20**	**10**	**1**	**16**	**27**	**300**	**325**	**225**	**450**	**1000**

Mandatory Courses for Honours with Specialization in Artificial Intelligence and Data Science /Honours with Specialization in Artificial Intelligence and Machine Learning/ Honours with Specialization in Generative AI

S.No	Course Code	Course Name	Component NEP	Component AICTE Nomenclature	Credit	L	T	P	Contact Hr.	TW+SL	CIE	MSE	ESE	Total
1	TCS203	Fundamentals of AI and ML	DSC	PCC	3	3	-	-	3	45	25	25	50	100
2	PCS253	AI and ML Lab using Python	DSC	LC	1	-	-	2	2	15	25	25	50	100

MNG Course

1	**TEV101/201**	**Environmental Science**	**VAC**	**MNG**	**2**	**2**	**0**	**0**	**2**	**30**	Qualified/ NoN Qualified	

Note: ** Subject applicable for those students opting Honours with Specialization in Artificial Intelligence and Data Science or Honours with Specialization in Artificial Intelligence and Machine Learning or Honours with Specialization in Generative AI.

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I

Name of Department: - Computer Science and Engineering

Course Code:		**TCS101**	**Course Title:**	Fundamental of computer and introduction to programming		
Credits:	3	**Semester:**	I	**Category of Course:**	DSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**
3	0	0		25	25	50
Examination Duration (Hrs):			**Theory**		**Practical**	
			3		0	

Pre-requisite: Basic Knowledge of Mathematics

Course Outcome:	CO1: Learn the concepts of IT and understand the fundamentals of basic building blocks of computer science. CO2: Learn fundamentals of programming and propose problem solutions using algorithms and flowcharts. CO3: Understand fundamentals, basic semantics and syntax of C programming with application of decision-making constructs. CO4: Analyse and solve programming problems by applying iterative control structures. CO5: Implement complex problems as a collection of sub problems by applying modularization in applications using functions.

Details of the Course:

Sl. No.	Contents	Contact Hours
1	**UNIT- I** Modern electronic computer architecture-Von Neumann architecture, software & hardware, computer system memory hierarchy, RAM/ROM, data representation and number system (binary, octal and hexadecimal), BIOS, Booting process, Operating System overview, Computer Networks Overview	**5**
2	**UNIT- 2** Assembly language, machine language and high-level language, compiler, assembler, interpreter, linker, loader, and executable files. machine language, assembly language and high-level language, Life of a C program (Preprocessing, Compilation, Assembly, Linking, Loading, Execution), Algorithms & Flowchart: Sequential, conditional and iterative, Categorization and identification of Syntax, Semantic, Linker, and Runtime errors	**8**
3	**UNIT- III** Classification of C tokens, data types, Data type qualifiers, structure of C program, local and global variables, operators- Arithmetic, Relational, Logical, Assignment, Increment/Decrement, Bitwise, Conditional (Ternary), and Special operators. Operator precedence and associativity rules, type casting, Formatted console functions (printf(), scanf()) and unformatted functions (getchar(), putchar()). Macros-symbolic constants. Decision making statements- Simple if statement, if-else structures, and nested if-else frameworks. Multi-way selection: if-else-if ladder block, switch-case multi-conditional statement	**10**

4	**UNIT- IV** Iterative Statements (Looping): Entry-controlled loops: while and for loop structures, Exit-controlled loops: do-while loop, Nested loops execution and multi-dimensional tracking. Precise controls via break, continue, and goto statements	**10**
5	**UNIT- V** Concepts of modularity, function prototypes (Declaration), Parameter lists, Definition, and Execution (Function Calls), Call by Value, activation record, memory segmentation, Recursion: definition, stack representation of function call and classical mathematical implementations (Factorial, Fibonacci sequence generation), static and dynamic linking, Storage Classes: scope, lifetime, and linkage visibility of variables using auto, extern, static, and register memory directives	**10**
	Total	**43**

Text Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Peter Prinz, Tony Crawford	C in a Nutshell	1st	O,Reilly Publishers,USA	2011
Peter Norton	Introduction to computers	6th	TMH Publication, India	2009
E.Balagurusamy	Programming in ANSI C	6th	McGraw Hill Education, American	2015

Reference Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Steve Oualline	Practical C programming	**3rd**	O,Reilly Publishers,USA	**2011**
Brian W Kernighan,	"The C Programming	**2nd**	Prentice Hall, India	**2000**

Dennis M Ritcie	Language			
Yashwant Kanetkar	Let Us C	**8th**	BPB Publication, India	**2007**

New Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
TCS101.1	Learn the concepts of IT and understand the fundamentals of the basic building blocks of computer science.	2								1		1
TCS101.2	Learn fundamentals of programming and propose problem solution using algorithm and flowcharts.	2								1		1
TCS101.3	Understand fundamentals, basic semantics and syntax of C programming with application of decision-making constructs.	3								1		1
TCS101.4	Analyse and solve programming problems by applying iterative control structures.	3	1							1		1
TCS101.5	Implement complex problems as a collection of sub problems by applying modularization in applications using functions.	3	1							1		1
TCS101		2.60	1.00							1.00		1.00

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER II

Name of Department: - Computer Science and Engineering

Course Code:		**TCS201**	**Course Title:**	Programming for Problem Solving		
Credits:	3	**Semester:**	II	**Category of Course:**	DSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**
3	0	0		25	25	50
Examination Duration (Hrs):			**Theory**		**Practical**	
			3		0	

Pre-requisite: TCS 101 Fundamental of Computer and Introduction to Programming

Course Outcome:	After completion of the course the students will be able to**:** CO1: Learn and apply concepts of array for providing solutions to homogenous collection of data types CO2: Apply the concept of pointers to optimize memory management by overcoming the limitations of arrays. CO3: Learn and implement string handling and manipulation operations for problem solving CO4: Process and analyze problems based on heterogeneous collections of data using structures. CO5: Apply concepts of file handling to implement data storage and retrieval tasks.

Details of the Course:

Sl. No.	Contents	Contact Hours
1	**UNIT- I** **Arrays**- One-dimensional arrays, Array initialization, computing address of an element in an array, character arrays, segmentation fault, bound checking, Searching: Linear and Binary Search, Sorting: bubble and selection sort. Two-Dimensional Arrays- Initializing arrays, row major and column major implementation and address calculation.	**10**
2	**UNIT- II** **Pointers** –Basic of pointers and addresses, Pointers and arrays, Pointer arithmetic, passing pointers to functions, call by reference. Accessing string through pointers. Dynamic memory management in C - malloc(), calloc(), realloc(), free(), memory leak, Dangling, Void, Null and Wild pointers	**7**
3	**UNIT- III** **Strings** – Declaration of strings, Initialization of string, standard library functions of string, strings and function, string and pointers. Strings using Dynamic memory allocation.	**10**
4	**UNIT- IV** **Structures** - Structures, structure initialization, accessing structure members, array of structures, structure within structure, structure and function, union, typedef, pointer to structure, self-referential structure, Bit field.	**8**
5	**UNIT- V** **File Handling** - Opening or creating a file, closing a file, File modes, Reading and writing a text file using getc(), putc(), fprintf() ,fscanf(),fgets(), fputs(), Reading and writing in a binary file, counting lines in a text file, Search in a text file, Random file accessing methods- feof(), fseek(), ftell() and rewind() functions.	**10**
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Peter Prinz, Tony Crawford	C in a Nutshell	**1st**	O'Reilly,United Kingdom	2011
Yashwant Kanetkar	Let Us C	**8th**	BPB Publication,India	2007

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Steve Oualline	Practical C programming	**3rd**	O'Reilly,United Kingdom	**2011**
Brian W Kernighan, Dennis M Ritcie	The C Programming Language	**2nd**	Prentice Hall, American	**2000**
E.Balagurusamy	Programming in ANSI C	**6th**	McGraw Hill Education, American	**2015**

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
TCS201.1	Learn and apply concepts of array for providing solutions to homogenous collection of data types	3	2	1						1		1
TCS201.2	Apply the concept of pointers to optimize memory management by overcoming the limitations of arrays.	3	3	1						1		1
TCS201.3	Learn and implement string handling and manipulation operations for problem solving	3	2	1						1		1
TCS201.4	Process and analyse problems based on heterogeneous collection of data using structures.	3	3	1						1		1
TCS201.5	Apply concepts of file handling to implement data storage and retrieval tasks.	3	2	1						1		1
TCS201		3.00	2.40	1.0						1.0		1.0

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I

Name of Department: - Computer Science and Engineering

Course Code:		**TCS104**	**Course Title:**		**Computational Thinking**		
Credits:	3	**Semester:**	I	**Category of Course:**		DSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**			
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**	
3	-	-		25	25	50	
Examination Duration (Hrs):			**Theory**		**Practical**		
			3		-		

Pre-requisite: High school Mathematics.

Course Outcome:	After completion of the course the students will be able to: CO1: Apply computational thinking principles and standard Python constructs to read, understand, trace, predict and write Python programs to solve simple, well-defined computational problems. CO2: Design and debug modular solutions to multi-tiered application-based problems in Python CO3: Apply recursive and decomposition strategies to solve problems, and reason about their correctness and termination. CO4: Analyse, generalize, and compare the behaviour and efficiency of algorithms using formal complexity notation CO5: Create integrated computational solutions using appropriate data structures, design, and tools.

Details of the Course:

UNIT	**CONTENTS**	**Contact Hrs**

Unit - I	Introduction to computational thinking; problem decomposition; pattern recognition; abstraction; elementary discrete math, logical and algorithmic reasoning for step-by-step solution design; Python: Introduction to Python environment; core syntax, built-in types, control structures, functions and collections.	9
Unit - II	Modular program design; Floats and approximation; higher-order and declarative computation; Python: (OOP) Objects and classes, abstraction, Inheritance, Polymorphism; any(), all(), sum(), map(), filter(), zip(), scope, string and list manipulations; comprehensions, sets, and the standard library, tuples, mutability, aliasing and cloning, lambda functions.	9
Unit - III	Inductive reasoning; recursion, divide and conquer; backtracking; core searching and sorting techniques; brute force and improved approaches; simplistic introduction to time and space complexity; big O, theta and omega notations Python: First-class functions; Dictionaries; nested functions; standard I/O; file handling, pass, del, None; Testing and Debugging; Exception handling; functions (default, keyword, and variable-length arguments);	9
Unit - IV	Algorithm design strategies; selection of appropriate data structures; reasoning about algorithm correctness and efficiency; solving numerical, logical and application-oriented computational problems; solution refinement and optimization; comparative analysis of alternative solution strategies.	10
Unit - V	Integrated, multi-stage problem solving synthesizing prior units; introduction to data handling and analysis; Python: Modules and packages; introduction to **NumPy**, **Pandas**, and **Matplotlib** for scientific computing and data analysis	8
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Allen B. Downey	How to Think Like a Computer Scientist	3rd	O'Reilly	2024

Eric Matthes	Python Crash Course: A Hands-On, Project-Based Introduction to Programming	3rd	No Starch Press	2023
Reema Thareja	Python Programming: Using Problem Solving Approach	3rd	Oxford University Press, India	2025
Yashvant Kanetkar	Let Us Python	5th	BPB Publications, India	2023

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Wes McKinney	Python for Data Analysis: Data Wrangling with Pandas, Numpy and Jupyter	3rd	O'Reilly Media, USA	2022
Aditya Bhargava	Grokking Algorithms	1st	Manning Publications, USA	2016
Joel Grus	Data Science from Scratch: First Principles with Python	2nd	O'Reilly Media, USA	2019

Course Articulation Matrix

CO#	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	Apply computational thinking principles and standard Python constructs to read, understand, trace, predict and write Python programs to solve simple, well-defined computational problems	3	3	2	1	2	1	1	2	2	2	3	3	2	3	1
2	Design and debug modular solutions to multi-tiered application-based problems in Python	2	2	3	1	3	3	2	2	2	1	3	2	3	2	-
3	Apply recursive and decomposition strategies to solve problems, and reason about their correctness and termination.	3	3	2	2	2	1	1	2	1	2	1	1	1	3	-
4	Analyse, generalize, and compare the behaviour and efficiency of algorithms using formal complexity notation	3	3	3	2	2	3	1	2	1	2	3	3	1	3	1
5	Create integrated computational solutions using appropriate data structures, design, and tools	3	2	3	2	3	2	3	3	3	3	3	3	3	3	2
	Course Average	**2.8**	**2.6**	**2.6**	**1.6**	**2.4**	**2**	**1.6**	**2.2**	**1.8**	**2**	**2.6**	**2.4**	**1.8**	**2.8**	**1.33**

High correlation (3); Medium correlation (2); Low correlation (1); No correlation (-).

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I

Name of Department: - Computer Science and Engineering

Course Code:		**PCS154**	**Course Title:**		**Python Programming Lab**		
Credits:	1	**Semester:**	I	**Category of Course:**		DSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**			
L	**T**	**P**	30	**CIE**	**MSE**	**ESE**	
	-	2		25	25	50	
Examination Duration (Hrs):			**Theory**		**Practical**		
			-		2		

Pre-requisite: High school Mathematics.

Course Outcome:	After completion of the laboratory component the students will be able to: CO1: Apply Python constructs to implement solutions to specified computational problems. CO2: Analyze program behaviour against test cases to identify correctness and efficiency issues. CO3: Utilize and implement Python libraries (NumPy, Pandas) for data manipulation, transformation, statistical analysis, and visualization using Matplotlib/Seaborn

Details of the Course:

UNIT	CONTENTS	Contact Hrs
1	1. Design, Develop and implement a menu driven program in Python to perform the following tasks:	2

	a. Read three numbers and print largest of it b. Read a number and print sum of its digit c. Read a number and print reverse of the number (without using built in functions) Support the program with appropriate functions for each of the above tasks	
2	A university portal allows students to check their CGPA. The system takes total marks and total credits as input. If the user enters invalid input, the program should handle it appropriately. Finally, display the CGPA rounded to 2 decimals.	2
3	Design a custom Python module named math_utils that contains the following functions: a. is_prime(n): Check if a number is prime. b. factorial(n): Compute the factorial of a number using recursion. c. convert_to_binary(n): Convert a number into its binary representation. Then, in your main program, a. Import this module. b. Take a number as input from the user. c. Use functions from your module to check if the number is prime, find its factorial, and display its binary representation. Also, handle exceptions if the user enters invalid (non-integer or negative) values.	2
4	A restaurant billing system displays a menu with items and prices. Develop a program that should: a. Show food items with prices. b. Take the user's order (multiple items) c. Calculate the total bill. d. Apply a 10% discount if the bill is above ₹500. e. Exit option to close billing. • Use functions for add_to_order, calculate_total, apply_discount. • Use **match-case** for menu selection. Handle invalid inputs using exceptions.	2
5	Create a custom module shopping_utils.py with functions: a. add_item(cart, item, price) → adds item (dictionary:	2

	b. {"item": price}) to the shopping cart (list). c. remove_item(cart, item) → removes item if present, else raise a custom exception. d. unique_items(cart) → returns all unique items using a set. e. bill_summary(cart) → returns a tuple containing (total_items, total_cost). In the main program, import the module and: - Build a shopping cart interactively. Use exception handling when removing unavailable items.	
6	Design, develop and implement a menu driven program in Python for the following operations on a file : a. Read b. Write c. Append d. Delete e. Exit Support the program with appropriate functions for each of the above errors.	2
7	Design, develop and implement a menu driven Program in Python for the following set operations a. Union() b. Intersection() c. Difference() d. Symmetric_Difference() Support the program with appropriate functions for each of the above operation	2
8	Design, develop and implement a menu driven program in Python for the following a. Add a new contact (Name, Phone Number, Email). i. Store contacts in a dictionary ({name: (phone, email)}). ii. Validate phone number (10 digits) and email using regex. b. View all contacts. c. Search contact by name. d. Delete a contact. e. Save all contacts to a text file (phonebook.txt) and load back when program starts. f. Exit.	2

	Use exception handling for graceful handling of errors.	
9	Develop a Python program to manage student records where each student has: a. Roll number, name, and marks in 3 subjects. b. Store student data in a list of dictionaries. c. Allow the user to: I. Add a new student. II. Search for a student by roll number. III. Display the student with the highest average. d. Save the records into a text file and load them back when the program starts. Use exception handling for invalid inputs.	2
10	You are given a server log file that contains lines like: [2026-08-16 10:25] ERROR: Connection failed for user admin [2026-08-16 10:30] INFO: User guest logged in [2026-08-16 10:35] ERROR: Disk full for user root Design a program to: a. Extract all unique usernames using regular expressions. b. Count how many times each type of log level (INFO, ERROR, WARNING) appears. Store the summary in a new file called log_summary.txt.	2
11	Design a Book class with attributes title, author, and is_available. Implement methods to issue and return a book. Create objects for at least 3 books and demonstrate their usage	2
12	Create a base class Vehicle with attributes brand and model. Extend it into Car (extra attribute: doors) and Bike (extra attribute: engine_capacity). Implement methods to display full details of each. Design a menu-driven program that allows the user to choose from a set of string operations (e.g., palindrome check, anagram test, word count), each implemented in a separate function within a custom module	2
13	Develop a payment system program to demonstrate method overloading and method overriding: a. Create a base class Payment with a method make_payment(amount). b. Implement method overloading in the Payment class by	2

	allowing make_payment to accept either one argument (amount) or two arguments (amount, currency). c. Create two subclasses CreditCardPayment and PayPalPayment that override the make_payment(amount) method to provide their own implementations. Demonstrate both overloading (different parameter lists in the same class) and overriding (redefining the method in subclasses) by processing payments through different objects.	
14	Create a BankAccount class with private attribute balance. Implement public methods to deposit(amount), withdraw(amount), and check_balance(). Demonstrate encapsulation by performing valid and invalid operations.	2
15	Define an abstract base class DeliveryService with abstract methods calculate_charges(weight) and track_package(id). Create two subclasses DHL and FedEx implementing these methods. Demonstrate abstraction by calling methods using base class reference.	2
16	A fitness app records the daily step counts of a user for 30 days in a NumPy 1D array. a. Calculate the average, minimum, and maximum step count. b. Find the number of days the user achieved more than 10,000 steps. c. Identify the day (index) with the highest step count.	2
17	You are given a dataset of employees with columns: EmployeeID, Department, Salary, and JoiningDate.Write Pandas code to: a. Find the average salary of employees in each department. b. Display employees who joined after 2020-01-01. c. Merge this DataFrame with another DataFrame containing EmployeeID and PerformanceScore	2
18	A health dataset contains columns: Age, Cholesterol_Level, and Heart_Disease (Yes/No). Plot the following: a. A histogram of cholesterol levels. b. A scatter plot of Age vs. Cholesterol, with color indicating heart disease presence. c. A box plot of cholesterol levels grouped by heart disease.	2
19	You are working with a customer dataset containing CustomerID, Age, AnnualIncome, and SpendingScore. Some values are missing or duplicated. Write steps to: a. Handle missing values (mean imputation for Age, drop rows with missing CustomerID).	2

	b. Remove duplicate rows. c. Perform correlation analysis between AnnualIncome and SpendingScore and interpret the result.	
20	A retail company provides transaction data with columns: TransactionID, CustomerID, PurchaseAmount, PurchaseDate, PaymentMethod. a. Load the dataset into Pandas and check for null values. b. Using NumPy/Pandas, calculate the total purchase per customer. c. Group purchases by PaymentMethod and display the total and average purchase amounts. d. Plot a bar chart showing the number of transactions per payment method. e. Perform EDA to check if there is any correlation between PurchaseAmount and PaymentMethod.	2
	Total	**40**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Yashvant Kanetkar	Let Us Python	5th	BPB Publications, India	2023
Eric Matthes	Python Crash Course: A Hands-On, Project-Based Introduction to Programming	3rd	No Starch Press	2023
Reema Thareja	Python Programming: Using Problem Solving Approach	3rd	Oxford University Press, India	2025

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Wes McKinney	Python for Data Analysis: Data	3rd	O'Reilly Media, USA	2022

	Wrangling with Pandas, Numpy and Jupyter			
Aditya Bhargava	Grokking Algorithms	1st	Manning Publications, USA	2016
Joel Grus	Data Science from Scratch: First Principles with Python	2nd	O'Reilly Media, USA	2019

Course Articulation Matrix

CO #	Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO3
1	Apply Python constructs to implement solutions to specified computational problems	3	-	2	-	2	-	2	-	1	2	2	1	3	1
2	Analyze program behaviour against test cases to identify correctness and efficiency issues	2	1	2	2	3	-	1	-	1	1	2	3	2	-
3	Utilize and implement Python libraries (NumPy, Pandas) for data manipulation, transformation, statistical analysis, and visualization using Matplotlib/Seaborn	-	-	3	3	3	2	2	2	1	-	2	1	3	-

	Course Average	**2.5**	**1**	**2.3**	**2.5**	**2.6**	**2**	**1.6**	**2**	**1**	**1.5**	**2**	**1.6**	**2.6**	**1**

High correlation (3); Medium correlation (2); Low correlation (1); No correlation (-).

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I

Name of Department: - Computer Science and Engineering

Course Code:		**PCS151**	**Course Title:**	**COMPUTER LAB I**		
Credits:	2	**Semester:**	I	**Category of Course:**	DSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**
0	0	4		25	25	50
Examination Duration (Hrs):			**Theory**		**Practical**	
			0		4	

Pre-requisite: Basic knowledge of computer.

Course Outcome:	After completion of the course the students will be able to**:** CO1: Learn and apply the simple programs using input/output function and different categories of operators combined with decision making statements. CO2: Develop and implement C programs using single and nested looping constructs to solve iterative, pattern-based, and computational problems efficiently. CO3: Propose solution to problem by modularizing it into small units using function and recursion.

Details of the Course:

Sl. No.	**List of problems for which student should develop program and execute in the Laboratory**	**Contact Hours**
1.	WAP to print Hello World using C. Sample Output : Hello World!	2hrs
2.	WAP to find sum of two numbers without using scanf() function. Sample Output: Sum of 5.000000 and 6.000000 is : 11.000000	2hrs
3.	WAP to compute Net salary on the basis of given data. Sample Input: Enter the Basic Salary of Employ: 20000 Sample Output: HRA is: 2000.000000 TA is: 1000.000000 DA is: 3000.000000 Employ Net Salary is 26000.000000	2hrs

4.	WAP to convert temperature form Fahrenheit to Celsius Sample Input: Enter the Temperature in Fahrenheit 97 Sample Output: Temperature in Celsius is: 36.111111	2hrs
5.	WAP to find roots of quadratic equation. Sample Inout: Enter coefficients a, b and c: 4 1 0 Sample Output: Roots are real numbers..... Roots are: 0.00 and -0.25	2hrs
6.	WAP to swap two numbers using third variable. Sample Input: Enter First Number: 10 Enter second number: 20 Sample Output: Before swapping first number is 10.000000 and second number is 20.000000 After swapping first number is 20.000000 and second number is 10.000000	2hrs
7.	WAP to swap two numbers without using third variable Sample Input: Enter First Number: 10 Enter second number: 20 Sample Output: Before swapping first number is 10.000000 and second number is 20.000000 After swapping first number is 20.000000 and second number is 10.000000	2hrs
8.	WAP to find whether a number is even or odd. Sample Input: Enter a number5 Sample Output: Number entered is odd	2hrs
9.	WAP to find largest of three number and display numbers in ascending order Sample Input: enter the three numbers6 4 9 Sample Output: Numbers in Ascending order is 4	2hrs

	6 9	
10.	WAP to find whether a given character is vowel or consonant. Sample Input: enter a character:t Sample Output: Entered Character is a consonant	2hrs
11.	WAP to calculate SI if principal amount is less than 10000 else CI. Sample Input: enter the principle rate time 1000 3 4 Sample Output: Compound Interest Rs10000.000000	2hrs
12.	WAP to input a character and find whether it is number, alphabet or special symbol. Sample Input: enter a characterA Sample Output: Entered Character is an alphabet Sample Input: enter a character: Sample Output: Entered Character is a special symbol	2hrs
13.	WAP to find sum and average of ten numbers using for, while and do-while loop. Sample Input: Enter 1 element:12 Enter 1 element:34 Enter 1 element:12 Enter 1 element:5 Enter 1 element:4 Enter 1 element:6 Enter 1 element:7 Enter 1 element:8 Enter 1 element:3 Enter 1 element:1 Sample Output: Sum of the 10 given elements is= 92.00 Average of given 10 elements is= 9.20	2hrs
14.	WAP to find sum of digits of number . Sample Input: Enter a number:1234	2hrs

	Sample Output: Sum of digits of given number is=10	
15.	WAP to find whether a given number is prime or not. Sample Input: Enter a number:12 Sample Output: The entered number is not prime	2hrs
16.	WAP to print Fibonacci Series upto N Terms. Sample Input: Enter the limit of Fibonacci series5 Sample Output: 0 1 1 2 3 5 8	2hrs
17.	WAP to find whether a number is Armstrong number or not. Sample Input: Enter a number=153 Sample Output: The given number is Armstrong Sample Input: Enter a number=567 Sample Output: Not Armstrong	2hrs
18.	WAP to find whether a number is palindrome number or not. Sample Input: Enter a number=151 Sample Output: The given number is palindrome	2hrs
19.	WAP to print the given pattern: **1)** **1** **0 1** **1 0 1** **0 1 0 1** **1 0 1 0 1** 2) **A** **B C** **D E F** **G H I J** **Sample Input:** Enter value of n to generate pattern 3 Sample Output:	2hrs

	Pattern of digit 1 and 0 1 0 1 1 0 1 Patter of alphabet A B C D E F	
20.	WAP to find the sum of given series: a) $1^2+2^2+3^2+$.....upto n terms b) $1^2-2^2+3^2-4^2$……upto n terms Sample Input: Enter value of 'n' to calculate sum of series upto n terms 3 Sample Output: sum of series upto 3 terms = 14 Sample Input: Enter value of 'n' to calculate sum of series upto n terms 4 Sample Output: sum of series upto 4 terms = -10	2hrs
21.	WAP to find the sum of two numbers using function. Sample Input: Enter first number: 3 Enter second number: 5 Sample Output: Sum of the entered numbers: 8	2hrs
22.	WAP to return reverse of a number. Sample Input: Enter the number to reverse:342 Sample Output: Reverse of 342 is = 243	2hrs
23.	WAP to find the X^Y using recursion. Sample Input: Enter base number:4 Enter power number(positive integer):2 Sample Output: 4^2=16	2hrs
24.	WAP to find the sum of natural numbers using function Sample Input: Enter a positive integer: 5 Sample Output: Sum=15	2hrs
25.	WAP to evaluate the sum of the following prime series and returns the summation to the calling program. implement a c program to read the value of n in the main program. 1 + 2+ 3+ 5 + 7 + 11 + 13 + 17+……..n.	2hrs

	Output: Enter the value of N: 17 Sum of prime numbers up to 17 = 58	
26.	WAP to compute following series till n terms: a. 1+(1+2)+(1+2+3)+(1+2+3+4)+.....+(1+2+3+.....n) b. 1-1/3+1/5-1/7+1/9.....upto n terms. c. 1+2/2!+3/3!+4/4!.....n/n! d. 12-22+32-42……upto n terms Output: Menu 1. Series A 2. Series B 3. Series C 4. Series D 5. Exit Enter your choice: 1 Enter the value of n: 4 Sum = 20 Menu 1. Series A 2. Series B 3. Series C 4. Series D 5. Exit Enter your choice: 5 Exiting... Menu 1. Series A 2. Series B 3. Series C 4. Series D 5. Exit Enter your choice: 2 Enter the value of n: 5 Sum = 0.834921 Menu 1. Series A 2. Series B 3. Series C 4. Series D 5. Exit Enter your choice: 5 Exiting...	2hrs
27.	Write a C Program for the following series. Read the number of terms N as the input in the main program. 1/2 ! + 2/5! + 3/10! + 4/17! + 5/26!.....up to N terms.	2hrs

	Output: Enter the number of terms: 5 Sum of the series = 0.5000330715	

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Peter Prinz, Tony Crawford	C in a Nutshell	2nd	O,Reilly Publishers,USA	2015
Peter Norton	Introduction to computers	6th	TMH Publication, India	2009
E.Balagurusamy	Programming in ANSI C	11th	McGraw Hill Education, American	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Steve Oualline	Practical C programming	**3rd**	O,Reilly Publishers,USA	**2011**
Brian W Kernighan, Dennis M Ritcie	"The C Programming Language	**2nd**	Prentice Hall, India	**2008**
Yashwant Kanetkar	Let Us C	**18th**	BPB Publication, India	**2023**

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PCS151.1	Learn and apply the simple programs using input/output function and different categories of operators combined with decision making statements .	1				1				1		1
PCS151.2	Develop and implement C programs using single and nested looping constructs to solve iterative, pattern-based, and computational problems efficiently.	2				1				1		1
PCS151.3	Propose solution to problem by modularizing it into small units using function.	2	1			1				1		1
PCS151		**1.67**	**1.0**			**1.0**				**1.0**		**1.0**

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER II

Name of Department: - Computer Science and Engineering

Course Code:		**TCS203**	**Course Title:**		**Fundamentals of Artificial Intelligence and Machine Learning**		
Credits:	3	**Semester:**	II	**Category of Course:**	DSC		
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**			
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**	
3	0	0		25	25	50	
Examination Duration (Hrs):			**Theory**		**Practical**		
			3		0		

Pre-requisite: TCS101

Course Outcome:	After completion of the course, the students will be able to**:** CO1: Define Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning, and differentiate between them. Explain problem-solving frameworks in AI and describe search strategies like breadth-first, depth-first, and A*. CO2: Classifying learning as supervised, unsupervised and reinforcement learning and perform data cleaning and choosing appropriate regression or classification techniques like Linear Regression, Logistic Regression, KNN, or SVM based on specific data characteristics. CO3: Develop decision tree and ensemble learning based models and compare and contrast different performance metrics like accuracy, precision, recall, and F1-score for evaluating ML models. CO4: Evaluate the strengths and limitations of specific unsupervised learning techniques like K-means and hierarchical clustering for a given task. CO5: Design a simple machine learning pipeline involving data pre-processing, model selection, and evaluation for a classification task.

Details of the Course:

UNIT	Contents	Contact Hours

Unit - I	Overview of AI and Intelligent Agents Definition and history of AI, Differences between AI, ML, and deep learning, Applications and impact of AI in various sectors, Agents and environments, Types of agents (simple reflex, model-based, goal-based, utility-based), Agent architecture and environments Uninformed and Informed Search: Problem-solving frameworks, Search strategies: breadth-first, depth-first, A*.	**9**
Unit - II	Introduction to ML and Data Preprocessing What is Machine Learning? Types of Machine Learning: Supervised, Unsupervised, Reinforcement- ML in practice: Applications and case studies, Importance of data preprocessing, Data cleaning, normalization, and transformation, Feature selection: (Forward and Backward), and dimensionality reduction (PCA).	**9**
Unit – III	Regression Analysis Linear regression: Single and Multilinear Regression, Regularization methods: Ridge, Lasso Classification Techniques Logistic regression, K-nearest neighbors (KNN), Support vector machines (SVM)	**10**
Unit – IV	Decision Trees and Ensemble Techniques Building decision trees, Overfitting and pruning, Ensemble methods: Bagging and boosting Evaluation of ML Models Training and testing data splits, Performance metrics: accuracy, precision, recall, F1-score, Confusion matrix and ROC curves	**10**
Unit – V	Clustering and Association Rule Mining Clustering: Introduction, K-means clustering- Elbow method and Silhouette Score, Hierarchical clustering: Agglomerative and Divisive.	**10**
	Total	**48**

Text Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Stuart Russell and Peter Norvig	Artificial Intelligence: A Modern Approach	4th Edition	Pearson Education Limited, USA	2024
Melanie Mitchell	Introduction to Artificial Intelligence	2nd Edition	McGraw-Hill Education, USA	2024
Tom M. Mitchell,	Machine Learning	1st Edition	Mc Graw Hill Publisher	2017
Manaranjan Pradhan, U Dinesh	Machine Learning	1st Edition	Wiley, India	2017

Kumar	using Python			

Reference Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Richard E. Neapolitan and Kevin Goda	Artificial Intelligence: Foundations and Applications	4th Edition	Elsevier Science & Technology, Netherlands	**2024**
Aurélien Géron	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	2nd Edition	O'Reilly Media, Inc., USA	2024
E. Alpaydin,	Introduction to Machine Learning	3rd Edition	PHI Publisher	2015

Course Articulation Matrix

CO#	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10		PO11	PSO1	PSO2	PSO3
TCS203.1	Define Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning, and differentiate between them. Explain problem-solving frameworks in AI and describe search strategies like breadth-first, depth-first, and A*.	2	2	-	-	-	-	-	-	1	-		1	1	1	2
TCS203.2	Classifying learning as supervised, unsupervised and reinforcement learning and perform data cleaning and choosing appropriate regression or classification techniques like Linear Regression, Logistic Regression, KNN, or SVM based on specific data characteristics.	2	2	-	2	2	-	1	-	2	-		2	2	1	2
TCS203.3	Develop decision tree and ensemble learning based models and compare and contrast different performance metrics like accuracy, precision, recall, and F1-score for evaluating ML models.	2	2	-	2	2	-	1	-	1	1		1	2	1	2
TCS203.4	Evaluate the strengths and limitations of specific unsupervised learning techniques like K-means and hierarchical clustering for a given task.	1	2	-	2	2	-	1	-	1	1		1	2	1	1
TCS203.5	Design a simple machine learning pipeline involving data pre-processing, model selection, and evaluation for a classification task.	2	2	3	2	2	-	1	1	1	2		1	2	1	2
TCS203		**1.8**	**2**	**3**	**2**	**2**	**-**	**1**	**1**	**1.2**	**1.3**		**1.2**	**1.8**	**1**	**1.8**

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER II

Name of Department: - Computer Science and Engineering

Course Code:		**PCS251**	**Course Title:**	**COMPUTER LAB II**		
Credits:	2	**Semester:**	II	**Category of Course:**	DSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**
0	0	4		25	25	50
Examination Duration (Hrs):			**Theory**		**Practical**	
			0		4	

Pre-requisite: Computer Lab I (PCS151)

Course Outcome:	After completion of the course the students will be able to**:** CO1: Learn and implement the concept 1D and 2D arrays for providing solution to homogenous collection of data types. CO2: Apply concept of strings for providing solution to problems and the concept of pointers to optimize memory management by DMA. CO3: Implement structure and file handling for storage, retrieval and manipulation of records.

Details of the Course:

Sl. No.	**List of problems for which the student should develop a program and execute in the Laboratory**	**Contact Hours**
1.	WAP to find the sum and average of given N elements in an array. Output: Enter the number of elements: 5 Enter 5 elements: 10 20 30 40 50 Sum = 150 Average = 30.00	2hrs
2.	WAP to count numbers greater than, less than or equal to a number 'K' in an array by accepting the value of K from the user. Output: Enter the number of elements: 6 Enter the array elements: 10 25 15 20 30 20	2hrs

	Enter the value of K: 20 Numbers greater than 20 = 2 Numbers less than 20 = 2 Numbers equal to 20 = 2	
3.	WAP to read elements in an array, later store those elements in another new array in reverse order. Print the new array. Output: Enter the number of elements: 5 Enter the array elements: 10 20 30 40 50 Reversed array: 50 40 30 20 10	2hrs
4.	WAP to initialize an array of size 'N' by reading the integers from the user and find all the palindrome numbers present in it. Store all the palindrome numbers into another array and display the same to the output. Output: Enter the number of elements: 6 Enter the array elements: 121 234 44 567 989 100 Palindrome numbers are: 121 44 989	2hrs
5.	WAP to read N characters into an array and then find & display the character with maximum ASCII value to the console. Output: Enter the number of characters: 5 Enter the characters: A g M z B Character with maximum ASCII value = z	2hrs
6.	Implement the searching technique: a. Linear Search b. Binary Search Input: Array having N elements and key to be searched Output: Result if the key is found or not	2hrs
7.	WAP to Find Sum & Average of Elements in mxn Matrix. Input: Enter row and column size: 3 3 Enter matrix elements: a[0][0]=2 a[0][1]=4 a[0][2]=5 a[1][0]=1 a[1][1]=3 a[1][2]=6 a[2][0]=9 a[2][1]=7	2hrs

	a[2][2]=8 Output: Sum=45.000000 Average=5.000000	
8.	WAP input square matrix and print its transpose. Input: Enter the size of the square matrix:3 Enter elements of the matrix: 1 2 3 4 5 6 7 8 9 Output: Transpose of the matrix: 1 4 7 2 5 8 3 6 9	2hrs
9.	WAP input mxn matrix and print that it is lower triangular matrix or not. Input: Enter the Number of Rows:3 Enter the Number of Columns:3 Enter the Elements in the Matrix: 1 2 3 0 4 5 0 0 6 Output: Not the Lower Traingular Matrix	2hrs
10.	WAP to two 2D array and find theit sum. Input: Enter elements of 1st matrix: 1 2 3 4 Enter elements of 2nd matrix: 5 6 7 8 Output: Sum of the matrices: 6 8 10 12	2hrs
11.	WAP to show the use of different string library functions. Input Enter first string: Hello Enter second string: World Output: Concatenated String: HelloWorld Length: 10 Comparison Result: -15	2hrs
12.	WAP to calculate the length of the string. Input	2hrs

	Enter a string: Hello Output: Length = 5	
13.	WAP to insert a sub-string in a given main string from a given position. Input: Enter a string Comer Enter sub string Put Output: Enter position for insertion:3 String after Insertion is:Computer	2hrs
14.	WAP to delete n characters from the string from a given position. Input: Enter a string=jayapal Enter position for deletion=4 Enter number of characters to be deleted=2 Output: String after Deletion is:jayal	2hrs
15.	WAP to count the number of lines, words and characters in a given text. Input: TYPE ANY TEXT GIVE ONE SPACE AFTER EACH WORD. Ramu is a good boy. Output: Number of lines =1 Number of words =5 Number of characters =18	2hrs
16.	WAP to find the length of the string using Pointer. Input: Enter any String : pritesh Output: The Length of the given string pritesh is : 7	2hrs
17.	WAP to Display array elements using calloc( ) function. InputL Number of elements to be entered:3 Enter 3 numbers: 2 5 14 Output: The sum: 21	2hrs
18.	WAP to swap two numbers using call by reference. Input: 10 20 Output:	2hrs

	Before swapping: x = 10, y = 20 After swapping: x = 20, y = 10	
19.	WAP to find maximum element of an array using pointer. Input: Enter n: 5 Enter 5 elements: 15 22 9 31 5 Output: The maximum element in the array is: 31	2hrs
20.	WAP to Calculate Total and Percentage marks of a student using structure. Input: Enter RollNo, Name and three sub marks 12 rama 30 40 50 Output: rollno=12 Name=rama m1=30 m2=40 m3=50 total=120 per=40.000000	2hrs
21.	WAP that uses functions to perform the different operation on complex numbers using structure Sample Input/Output: ……. Menu for Complex Number Operations …… 1. Addition 2. Subtraction 3. Multiplication 4. Division 5. Exit Enter your choice: 1 Enter first complex number: Enter real part of complex number: 4 Enter imaginary part of complex number: 3 Enter second complex number: Enter real part of complex number: 2 Enter imaginary part of complex number: 5 Result: 6.00 + i8.00 …… Menu for Complex Number Operations …… 1. Addition 2. Subtraction 3. Multiplication 4. Division 5. Exit Enter your choice: 5 Exiting program...	2hrs
22.	WAP to display contents of a file.	2hrs

	Input: Enter the file name :sample.txt Output: this is my first program	
23.	WAP to copy the contents of one file to another Input: a.txt An array is a collection of elements of similar datatypes Output: 57 bytes copied from 'a.txt' to 'b.txt' 2 files closed	2hrs
24.	WAP to merge two files into a third file Input: Program to merge two files. Enter first file name: file1.txt Enter second file name: file2.txt Enter destination file name: merged.txt Output: File merging successful. Hello, this is file one. This is file two.	2hrs
	Total	**50Hrs**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Peter Prinz, Tony Crawford	C in a Nutshell	2nd	O,Reilly Publishers,USA	2015
Peter Norton	Introduction to computers	6th	TMH Publication, India	2009
E.Balagurusamy	Programming in ANSI C	11th	McGraw Hill Education, American	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Steve Oualline	Practical C programming	**3rd**	O,Reilly Publishers,USA	**2011**
Brian W Kernighan, Dennis M Ritcie	"The C Programming Language	**2nd**	Prentice Hall, India	**2008**
Yashwant Kanetkar	Let Us C	**18th**	BPB Publication, India	**2023**

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PCS251.1	Learn and implement the concept 1D and 2D arrays for providing solution to homogenous collection of data types.	2	2			1						1
PCS251.2	Apply concept of strings for providing solution to problems and the concept of pointers to optimize memory management by DMA.	2	2			1						1
PCS251.3	Implement structure and file handling for storage, retrieval and manipulation of records.	2	2	1		1			1			1
PCS251		**2.0**	**2.0**	**1.0**		**1.0**			**1.0**			**1.0**

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER II

Name of Department: - Computer Science and Engineering

<table>
<tr><td colspan="2">Course Code:</td><td colspan="2">PCS253</td><td colspan="2">Course Title:</td><td colspan="3">AI and ML Lab using Python</td></tr>
<tr><td>Credits:</td><td>1</td><td colspan="2">Semester:</td><td>II</td><td colspan="2">Category of Course:</td><td colspan="2">DSC</td></tr>
<tr><td colspan="4">TEACHING PERIODS
(In hours per week)</td><td colspan="2">TW+SL
(in hours per semester)</td><td colspan="3">Relative Weight</td></tr>
<tr><td>L</td><td colspan="2">T</td><td>P</td><td rowspan="2">45</td><td>CIE</td><td>MSE</td><td>ESE</td></tr>
<tr><td>0</td><td colspan="2">0</td><td>2</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td colspan="4" rowspan="2">Examination Duration (Hrs):</td><td colspan="2">Theory</td><td colspan="3">Practical</td></tr>
<tr><td colspan="2">0</td><td colspan="3">2</td></tr>
</table>

Pre-requisite: PCS152*

Course Outcome:	After completion of the course, the students will be able to**:** CO1: Design and develop programs to visualize data and perform Exploratory data analysis. CO2: Design and develop graph search algorithms such as BFS, DFS, and A* using heuristics. CO3: Design and develop Machine Learning models (Linear Regression, Logistic Regression, KNN, Decision Tree) and evaluate machine learning models using metrics (Confusion Matrix, F1 Score, Precision, Recall, Accuracy) and clustering.

Details of the Course:

Sl. No.	List of problems for which students should develop programs and execute in the Laboratory	Contact Hours
1.	**Exploratory Data Analysis and Visualization:** Implement a python program to create a dataset having columns student_id, student_name, age, height, weight, semester, gender, city and perform the following: i. Find the shape of the dataset. ii. Display the names of the columns. iii. Compute the no. of null values in each column. iv. Find unique names. v. Plot line graph between height and weight, height and age and weight and age. vi. Visualize the outliers present in height column using scatterplot. vii. Show the outlier in each column using boxplot. viii. Remove the outlier from the height column using iqr method. ix. Remove outlier from weight column using z-score method.	2
2.	Develop a python program to create dataset having height, weight, gender column and perform the following: i. Compute BMI using dataframe operations. ii. Save the dataset into CSV file. iii. Import the csv file and load it into a dataframe. iv. Find shape and size of dataframe. v. Find the count of null values in Gender column. vi. Remove null from gender column. vii. Display the structural and statistical information of the dataset. viii. Create a histogram on gender column. ix. Draw a suitable plot on the data and deduce some inference. x. Perform aggregate functions on height, weight and BMI column. xi. Find the entries where BMI is less than 20	2
3.	Given two datasets(medical_records.csv and patient_details.csv), perform the following tasks: i. Merge both the datasets on patient_id column and using inner join. ii. Impute null values in name column with value "unknown". iii. Rectify the negative values present in age column. iv. Make the values in gender column consistent by	2

	converting values M to Male and F to Female or vice-versa. v. Make the case of values in city column consistent. vi. Make the date format of admission_date consistent using regular expression. vii. Remove string value from height_cm column and impute the values. viii. Replace "high" from bp column with 140/90. ix. Impute sugar_level with mean value. x. Perform group by operation on gender column and compute mean, min and max of visit_cost for each gender. xi. Plot a histogram on diagnosis column.	
4.	**AI Overview and Search:** Design and develop programs to implement the Depth-First Search (DFS) algorithm for graph traversal in Artificial Intelligence with the following specifications: i. Construct a **static graph** consisting of **6 nodes and 10 edges,** where the graph is stored using a **dictionary representation.** The graph is given as: A- B, A-C, B-D, B-E, C-D, C-F, D-E, D-F, E-F, B-F. ii. Create another graph where the **number of nodes** and **number of edges** are provided by the user at runtime. iii. Accept the **initial node** and the **goal node** from the user. iv. Display the **path from the initial node to the goal node for both the cases.**	2
5.	Design and develop programs to implement the Breadth-First Search (BFS) algorithm for graph traversal in Artificial Intelligence with the following specifications: i. **Construct a static graph** consisting of **6 nodes and 10 edges**, where the graph is stored using a **dictionary representation.** The graph is given as: **A–B, A–C, B–D, B–E, C–D, C–F, D–E, D–F, E–F, B–F.** ii. **Create another graph dynamically**, where the **number of nodes and number of edges** are provided by the user at runtime, and the user specifies which nodes are connected. iii. **Accept the initial node and the goal node from the user.** iv**. Perform Breadth-First Search (BFS)** traversal starting from the given initial node and: v. Display the **order of node traversal** vi. Display the **shortest path from the initial node to the goal node** for **both the static and dynamic graph cases.**	2

<table>
<tr>
<td>6.</td>
<td>
Construct a program to implement the A* search algorithm using heuristic values for a given graph. The graph is stored using a dictionary representation. The graph consists of the following nodes and edge costs:
<table>
<tr><th>Path</th><th>Edge Cost</th></tr>
<tr><td>A-B</td><td>1</td></tr>
<tr><td>A-C</td><td>3</td></tr>
<tr><td>B-D</td><td>3</td></tr>
<tr><td>B-E</td><td>6</td></tr>
<tr><td>C-D</td><td>1</td></tr>
<tr><td>D-E</td><td>1</td></tr>
</table>
<table>
<tr><td>Node</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td></tr>
<tr><td>h(n)</td><td>7</td><td>6</td><td>4</td><td>2</td><td>0</td></tr>
</table>
Accept the initial node from the user and node E as goal node. Apply the A* algorithm to:
<ol type="i">
Display the order of node expansion
Display the optimal path
Display the total path cost

</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>
<h2>Machine Learning and Preprocessing:</h2>
Develop a Python program to perform normalization on a given healthcare dataset using Min–Max Scaler and Standard Scaler. The program should perform the following tasks:
<ol type="i">
Load the given dataset from the csv file(healthcare.csv).
Apply Min–Max normalization to scale the features.
Apply Standard Scaler to the same features.
Plot appropriate graphs to visualize the normalized data obtained from both methods.
Plot appropriate graphs to visualize the normalized data obtained from both methods.

</td>
<td>2</td>
</tr>
</table>

8.	Build a Python program to implement Forward Feature Selection and Backward Feature Elimination techniques using a given healthcare dataset that contains 200 records with multiple patient-related features. The program should perform the following: i. Load the dataset into dataframe. ii. Apply **Forward Feature Selection** using a Linear regression, kNN models and compare the results. iii. Apply **Backward Feature Elimination** using the same machine learning models and analyze the results. iv. Compare the feature sets selected by Forward Feature Selection and Backward Feature Elimination.	2
9.	Implement a program to perform dimensionality reduction using PCA on a Smart City Monitoring dataset(smart_city_monitor.csv) containing 100 samples and 20 features. The program should perform the following tasks: i. Load the given dataset from a CSV file. ii. Standardize the dataset before applying PCA. iii. Apply **Principal Component Analysis (PCA)** to reduce the dimensionality of the dataset. iv. Determine the number of principal components required to retain a significant amount of variance. v. Transform the dataset into the reduced feature space. vi. Visualize the data before and after dimensionality reduction and analyze the results.	2
10.	**Regression Analysis** You are given a dataset (salry_prediction.csv) containing years_of_experience as an input feature and salary as target. Implement a program to perform Simple Linear Regression and analyze the relationship between an input feature and a target variable and perform the following: i. Read the dataset into a dataframe and train a simple linear regression model after splitting the dataset into train and test data in the ratio of 70:30. ii. Determine the slope and intercept of the best fit line. iii. Plot the regression line along with actual data points. iv. Use the trained model to predict salary of new data points. v. Evaluate the performance of the model using appropriate regression metrics.	2
11.	**Consider a dataset (salary_prediction2.csv) containing multiple**	2

	input features related to employee performance and a target variable Salary**. Implement a program to perform Multiple Linear Regression and analyze the relationship between multiple input features and the target variable. Perform the following tasks:** i. Read the given dataset into a dataframe. **ii.** Split the dataset into **training and testing sets** in the ratio **70:30, 60:40, 80:20.** iii. Train a **Multiple Linear Regression model** using all input features to predict the target variable `Salary`. iv. Determine the **coefficients of each input feature** and the **intercept** of the best-fit regression model. **v.** Plot appropriate graphs to compare **actual vs predicted salary values.** vi. Use the trained model to **predict the salary for new data points** taken as input from the user. vii. Evaluate the performance of the model using appropriate regression metrics.	
12.	**Classification** **You are working on a dataset(diesea_risk.csv) containing multiple input features related to patient health parameters and a binary target variable** Disease_Risk**. Implement a program to perform Logistic Regression for binary classification and analyze the relationship between the input features and the target variable. Perform the following tasks:** i. Read the given dataset into a dataframe. ii. Split the dataset into **training and testing sets** in the ratio **70:30**. iii. Train a **Logistic Regression model** using the input features to predict the binary target variable Disease_Risk. iv. Determine the **model coefficients and intercept**. v. Evaluate the performance of the model using accuracy, and show the confusion matrix. vi. Use the trained model to **predict the class label for new data points**.	2
13.	Develop a program to implement the K-Nearest Neighbours (KNN) algorithm on a given dataset related to student performance with target as Result(student_performance.csv). The program should perform the following tasks: i. Read the given dataset into a dataframe. ii. Separate the input features and the target class label (`Result`). iii. Split the dataset into training and testing sets in the ratios 70:30, 60:40, 80:20.	2

	iv. Implement the K-Nearest Neighbours (KNN) classification algorithm for a suitable value of K. v. Train the model using the training data and classify the test samples. vi. Evaluate the performance of the model using accuracy, precision, F1 score and recall and show the confusion matrix. vii. Use the trained model to predict the class label for new data points.	
14.	Consider a dataset(loan_approval_dataset.csv) containing records related to loan applicants, where multiple input features are provided along with a binary target class label **`Loan_Approval`**. The program should perform the following tasks: i. Read the given dataset into a dataframe. ii. Separate the input features and the target class label (`Loan_Approval`). iii. Split the dataset into training and testing sets in the ratio 70:30. iv. Train a Decision Tree Classifier using the training data. v. Use the trained model to classify the test data. vi. Evaluate the performance of the classifier using appropriate classification metrics. vii. Predict the class label for new loan applicant data points.	2
15.	**Clustering:** Consider a dataset containing records related to customer purchasing behavior. The dataset includes multiple numerical features describing customer demographics and spending patterns.The program should perform the following tasks: i. Read the given dataset into a dataframe. ii. Perform necessary data preprocessing and feature scaling. iii. Apply the K-Means Clustering algorithm on the dataset for different values of K. iv. Determine the optimal number of clusters using the Elbow Method. v. Validate the clustering results using the Silhouette Score. vi. Perform clustering using the optimal value of K and assign cluster labels to the data points. vii. Visualize the formed clusters and analyze the clustering results.	2
16.	An online banking organization maintains a dataset containing customer information such as age, annual income, account balance, transaction frequency, credit score, and online banking activity. The organization wants to predict whether a customer is likely to subscribe to a newly launched premium banking service. Design and implement a machine learning solution using Support Vector Machines (SVM) and analyze the impact of different kernel functions on classification performance.	2

	Perform the following tasks: i. Load the customer subscription dataset into a DataFrame and examine its structure. ii. Analyze the dataset and perform appropriate preprocessing techniques, including handling missing values and encoding categorical attributes if required. iii. Apply feature scaling and divide the dataset into training and testing sets. iv. Construct and train SVM classifiers using different kernel functions. v. Evaluate each model using Accuracy, Precision, Recall, F1-Score, and Confusion Matrix. vi. Identify the most suitable kernel for the given dataset and justify your selection based on the obtained results.	
17.	A financial institution maintains a dataset containing transaction details such as transaction amount, transaction time, merchant category, customer spending behavior, and account activity. The objective is to identify fraudulent transactions and minimize financial losses. Perform the following tasks: i. Load the credit card transaction dataset into a DataFrame and examine its structure. ii. Analyze the dataset and perform suitable preprocessing techniques. iii. Split the dataset into training and testing sets. iv. Construct and train a Random Forest classifier using appropriate hyperparameters. v. Evaluate the model using Accuracy, Precision, Recall, F1-Score, ROC-AUC Score, and Confusion Matrix. vi. Analyze the feature importance scores generated by the Random Forest model.	2
	Total	**34**

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Stuart Russell, Peter Norvig	Artificial Intelligence: A Modern Approach	4th Edition	Pearson, USA	2021
Ethem Alpaydin	Introduction to Machine Learning	4th Edition	MIT Press, USA	2020
Aurélien Géron	Hands-On Machine Learning with Scikit-	3rd	O'Reilly Media,	2022

	Learn, Keras, and TensorFlow	Edition	USA	

CO#	**Statement**	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	PSO 3

Text Books:

Reference Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Tom M. Mitchell	Machine Learning	1st Edition	McGraw-Hill, USA	1997
Yahwant Kanetkar	Let Us Python	5th Edition BPB,	India	2023

Course Articulation Matrix

PCS253.1	Design and develop programs to visualize data and perform Exploratory data analysis.	3	3	2	3	3	1	1	1	2	2	1	3	3	1
PCS253.2	Design and develop graph search algorithms such as BFS, DFS, and A* using heuristics.	3	2	2	2	3	-	1	-	1	1	1	3	2	1
PCS253.3	Design and develop Machine Learning models (Linear Regression, Logistic Regression, KNN, Decision Tree) and evaluate machine learning models using metrics (Confusion Matrix, F1 Score, Precision, Recall, Accuracy) and clustering.	3	3	2	2	3	-	2	-	2	2	2	3	3	3
PCS253		**3**	**2.6**	**2**	**2.3**	**3**	**1**	**1.3**	**1**	**1.6**	**1.6**	**1.3**	**3**	**2.6**	**1.6**

High correlation (3); Medium correlation (2); Low correlation (1), No correlation (-)

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I/II

Department of Electronics and Communication Engineering								
Course Code:		**TEC 101/201**		**Course Title:**		**Basic Electronics Engineering**		
Credits:	2	**Semester:**		I/II	**Category of Course:**		DSC/ESC	
TEACHING PERIODS (In hours per week)				**TW+SL (in hours per semester)**	**Relative Weight**			
L	**T**	**P**		30	**CIE**	**MSE**	**ESE**	
2	0	0			25	25	50	
Examination Duration (Hrs):				**Theory**		**Practical**		
				3		0		
Pre-requisite				**Physics**				

9.	**Course Outcomes**	*After completion of the course the students will be able to:* ***CO1: Explain*** *the fundamental principles, concepts, and mathematical foundations related to electronic and digital systems.* ***CO2: Apply*** *analytical and problem-solving techniques for the design and analysis of basic electronic circuits and logical systems* ***CO3: Analyze*** *the behaviour and performance of semiconductor devices and electronic circuits under different operating conditions* ***CO4: Evaluate*** *different electronic circuit configurations and system design approaches for improved functionality and performance.* ***CO5: Design*** *and implement basic electronic and digital systems to meet specified operational requirements*

10. Details of the Course

Sl. No.	Contents	Contact Hours
1.	***Unit 1: Number Systems & Boolean Algebra****:* *Number systems and their conversion, Logic gates, Boolean algebra, Implementation of basic gates using universal gates, Implementation of logic functions using basic gates & universal gates, SOP & POS form of logic expression, Canonical form, Conversion from SOP & POS form to canonical form, Simplification of Boolean function: Algebraic method, Karnaugh map method (two, three & four variable K-map with don't care condition).*	10
2.	***Unit 2: Basics of Semiconductor Devices: P-N junction diode and BJT*** *Energy band theory: Classification of solids based on energy band diagram, Semiconductors; Intrinsic semiconductors, Extrinsic semiconductors– P-type and N-type, Mobility and conductivity, Mass action law, Charge densities in semiconductors, P-N Junction; Formation of depletion region, V-I characteristics of P-N junction diode, and Zener diode.*	10

	Construction of bipolar junction transistors (BJT), NPN and PNP type transistor, Characteristics; Common base and Common emitter configuration.	
3.	***Unit 3: AC to DC Conversion and Introduction of Operational amplifier:*** *Introduction to DC power supply, Rectifiers circuit: Half wave, Center tapped full wave and Bridge rectifier circuits. Rectifier performance parameter analysis (with and without capacitor filter).* *Introduction of Operational Amplifier: Inverting and non-Inverting Op-amp, Summing amplifier, Difference amplifier.*	*10*
	Total	***30***

11. Suggested Books

Sr. No.	***Name of Authors/Books/Publishers***	***Edition***	***Year of Publication / Reprint***
	Textbooks		
1.	*Jacob Millmann & Halkias,* ***"Integrated Electronics"****, TMH.*	*2nd*	*2009*
2.	*M. Morris Mano, Michael D. Ciletti,* ***"Digital Design"****, Pearson Education.*	*5th*	*2012*
	Reference Books		
1.	*Boylestad and L. Robert and Nashelsky Louis,* ***"Electronics Devices and Circuits Theory"****, Pearson Education,*	*10th*	*2009*
2.	*S. Salivahanan and S. Arivazhagan,* ***"Digital Circuits and Design"****, Oxford University Press,*	*5th*	*2008*

12.	***Mode of Evaluation***	*Test / Quiz / Assignment / Mid Term Exam / End Term Exam*

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I / II

Department of Electronics and Communication Engineering								
Course Code:		PEC 151/251		**Course Title:**		Basic Electronics Engineering Lab		
Credits:	1	**Semester:**		I/II	**Category of Course:**		DSC/LC	
TEACHING PERIODS (In hours per week)				**TW+SL (in hours per semester)**	**Relative Weight**			
L	**T**	**P**		--	**CIE**	**MSE**	**ESE**	
0	0	2			25	25	50	
Examination Duration (Hrs):				**Theory**		**Practical**		
				0		3		
Pre-requisite				**Physics**				

9.	**Course Outcomes**	*After completion of the course the students will be able to:* ***CO1:*** *Apply fundamental concepts and experimental techniques for testing, measurement, and analysis of basic electronic circuits and devices.* ***CO2:*** *Analyze the performance and characteristics of electronic components and circuits using appropriate laboratory instruments and methodologies.* ***CO3:*** *Design, implement, and verify basic electronic and digital circuits to meet specified functional requirements in laboratory applications*

10. Details of the Course

Sr. No.	List of problems for which student should develop program and execute in the Laboratory	Contact Hours
1.	Familiarization of electronics measuring instrument and components.	2
2.	Measure the voltage and frequency using a DSO.	2
3.	Study and verification of the truth table for logic gates.	2
4.	To design and verify the truth table for logic gates using NOR gate.	2
5.	To design and verify the truth table for logic gates using NAND gate.	2
6.	Study V-I characteristics of PN junction diode and determine the static and dynamic resistance from the characteristic curve.	2
7.	Study of a Half wave rectifier circuit with and without capacitor filter.	2
8.	Study of a Centre tapped full wave rectifier circuit with and without capacitor filter.	2
9.	Study of a bridge full wave rectifier circuit with and without capacitor filter.	2

10.	*Study V-I characteristics of Zener diode.*	*2*
11.	*Study the input and output characteristics of common base (CB) transistor.*	*2*
12.	*Study the input and output characteristics of common emitter (CE) transistor.*	*2*
	Total	***24***
Innovative Experiments		
13.	*Study the input and output characteristics of common collector (CC) transistor.*	*02*
14	*Design and verification of Inverting and non-inverting amplifier using Op-Amp IC.*	*02*
15.	*As suggested by the concerned faculty/lab in charge.*	*02*
	Total	***06***

11. Suggested Books

Sr. No.	***Name of Authors/Books/Publishers***	***Edition***	***Year of Publication / Reprint***
	Textbooks		
1.	*Jacob Millmann & Halkias, "**Integrated Electronics**", TMH.*	*2nd*	*2009*
2.	*M. Morris Mano, Michael D. Ciletti, "**Digital Design**", Pearson Education.*	*5th*	*2012*
	Reference Books		
1.	*Boylestad and L. Robert and Nashelsky Louis, "**Electronics Devices and Circuits Theory**", Pearson Education,*	*10th*	*2009*
2.	*S. Salivahanan and S. Arivazhagan, "**Digital Circuits and Design**", Oxford University Press,*	*5th*	*2008*

12.	***Mode of Evaluation***	*Test / Quiz / Assignment / Mid Term Exam / End Term Exam*

Department of Electrical Engineering								
Program: - Bachelor of Technology (Common to all the Programs)								
Semester	I/II	***Course Title***		**Basic Electrical Engineering**			***Code***	TEE 101/201
Course Components		***Credits***		***Contact Hours***		***L***	***T***	***P***
DSC		02				02	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***		***CWA***	***MSE***	***ESE***
		03	00			25	25	50
Pre-requisite	Basic Knowledge of Physics and Mathematics							
Course Outcomes								
CO1	Recall the concept of voltage, current, resistance and laws related to electricity with reference to the electrical circuits/systems.							
CO2	Understanding of fundamental laws and theorems used in the electrical circuits.							
CO3	Application of network theorems/laws in electrical circuit.							
CO4	Understanding of various electrical safety components and electrical wiring.							
CO5	Application of earthing/grounding.							
Unit No.	***Content***							***Contact Hours***
Unit -1	**DC Circuit:** Concepts of current, resistance, E.M.F., potential difference, Ohm's law, Simplifications of networks using series and parallel combinations and star-delta conversions, Kirchhoff's law, Superposition, Thevenin, Norton, Maximum Power Transfer theorem and their applications for network solutions.							10
Unit -2	**Single Phase AC:** Introduction of Single-Phase AC, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Single phase AC through R, L, C, and series combination of RLC.							10
Unit -3	**Electrical Installations and Illumination:** Wire and cables for internal wiring, switches, and circuits (Two-way switch, staircase wiring, go down wiring, double pole double throw switch), type of electrical wiring, Switch Fuse Unit (SFU), MCB, MCCB, Earthing concept and methods of earthing.							4
	Total Hours							24

Text Books/Reference Books:

1. D.P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", 4th Ed., Tata McGraw Hill, 2019
2. D.C. Kulshreshtha, "Basic Electrical Engineering", 2nd Ed., McGraw Hill, 2019
3. V. N. Mittle and Arvind Mittle, "Basic Electrical Engineering", 2nd Ed., Tata McGraw-Hill, 2017
4. L.S. Bobrow, "Fundamentals of Electrical Engineering", 12th Ed., Oxford University Press, 2003
5. V.D. Toro, "Electrical Engineering Fundamentals", 2nd Ed., Prentice Hall India, 2015
6. E. Hughes, "Electrical and Electronics Technology", 10th Ed., Pearson, 2010

DEPARTMENT OF ELECTRICAL ENGINEERING							
Course: - Bachelor of Technology							
Semester	First/Second	***Subject Title***		Basic Electrical Engineering Lab		***Code***	PEE 151/251
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
DSC		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Outcomes	
CO1	Understanding of basic electrical concepts i.e. voltage, current, power, energy etc.
CO2	Development of basic electrical circuit model for the verification of networks and theorems.
CO3	Analysis of various AC circuit parameters.
CO4	Understanding of basic concept of house wiring and measurement of electrical energy consumption.

Exp No.	***Name of the Experiment***
1.	To verify the Kirchhoff's Voltage Law (KVL) in DC circuit.
2.	To verify the Kirchhoff's Current Law (KCL) in DC circuit
3.	To verify Superposition theorem in DC circuit.
4.	To verify Thevenin's theorem in DC circuit.
5.	To verify Norton's theorem in DC circuit.
6.	To verify Maximum Power Transfer theorem in DC circuit.
7.	To find out the meter constant of a single-phase energy meter
8.	To wire for a Stair-case arrangement using a two-way switch.
9.	To measure power and power factor in a single-phase ac circuit with resistive load by using wattmeter.
10.	To draw the current versus frequency characteristics in RLC series circuit.
11.	To study various electrical accessories and machines parts (cut set model).

Department of Electrical Engineering							
Program: - Bachelor of Technology (Biotech)							
Semester	I	***Course Title***		**Basic Electrical & Electronics Engineering**		***Code***	EEC 201
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
DSC		04			03	01	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		03	00		25	25	50
Pre-requisite	Basic Knowledge of Physics and Mathematics						
Course Outcomes							
CO1	Recalling the concepts of basic electric circuits and remembering the theorems to solve DC Circuits						
CO2	Summarize the various characteristics of AC Circuits.						
CO3	Applying the concepts of magnetic circuits to understand the basic characteristics of single-phase Transformer.						
CO4	Analysing the basics of semiconductor devices used for electronic components.						
CO5	Evaluating the basic concept of PN junction diode and its applications in rectifier circuits and DC power supply.						
CO6	Compiling Bipolar Junction Transistor (BJT) from its basic concepts and various biasing circuits.						
Unit No.	***Content***						***Contact Hours***
Unit -1	**D.C. Network Theory:** Circuit theory concepts-KCL, KVL, mesh and node analysis, Network Theorems- Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Star Delta transformation.						07
Unit -2	**A.C. Circuit Analysis:** Sinusoidal and phasor representation of voltage and current, single phase a.c. circuit behavior of resistance, inductance and capacitance and their combination in series & parallel, power factor, series parallel resonance and quality factor.						07
Unit -3	**Magnetic Circuits:** Introduction, series-parallel magnetic circuits comparison, Eddy currentsand Hysteresis losses. **Single Phase Transformer:** Principle of operation, classification, phasor diagram at no load, efficiency, and all-day efficiency of transformer.						06
Unit -4	**Semiconductor Basics:** Insulators, semiconductors and metals, Mobility and conductivity, Intrinsic and extrinsic semiconductors and charge densities in semiconductors, Fermi Level, current components in semiconductors, continuity equation. **Junction Diode and Its Applications:** PN Junction diode – characteristic and analysis, Diode Models, Rectifiers, and filter circuit: Half wave, full wave and Bridge rectifier circuits and their analysis, L, C and Pi filters, Zener Diode, Basic regulator supply using Zener diode, Design of Regulator circuits.						10

Unit –5	**TRANSISTORS:** Construction and characteristics of bipolar junction, transistors (BJT's)- Comm. Base, Comm. emitter, Comm. Collector configuration, Transistor biasing and bias stabilization: - the operating point, stability factor, analysis of fixed base bias, collector to base bias, Emitter resistance bias circuit and self-bias circuit.	8
	Total Hours	38

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
D.P. Kothari and I. J. Nagrath	Basic Electrical Engineering	4th	Tata McGraw Hill,	2019
D.C. Kulshreshtha	Basic Electrical Engineering	2nd	McGraw Hill	2019
V. N Mittle and Arvind Mittle	Basic Electrical Engineering	2nd	Tata McGraw-Hill	2017
Jacob Millmann & Halkias	Integrated Electronics	2nd	Tata McGraw-Hill	2010
Boylestad and L. Robert and Nashelsky Louis	Electronics Devices and Circuits Theory	9th	PHI/Pearson Education.	2010

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
L.S. Bobrow	Fundamentals of Electrical Engineering	12th	Oxford University Press	2003
V.D. Toro	Electrical Engineering Fundamentals	2nd	Prentice Hall India	2015
E. Hughes	Electrical and Electronics Technology	10th	Pearson	2010

DEPARTMENT OF ELECTRICAL ENGINEERING							
Course: - Bachelor of Technology							
Semester	First	***Subject Title***		**Basic Electrical & Electronics Engineering Lab**		***Code***	**EEC 251**
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
DSC		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	03		25	25	50

Course Objectives	
CO1	**Illustrate** and **Verification** of various laws in DC circuit
CO2	**Illustrate** and **Verification** of various theorems in DC circuit
CO3	**Demonstrate** various types of diodes and their characteristics
CO4	**Analysis** of various types of analog and digital electronic circuits

Exp No.	***Name of the Experiment***
1.	To verify Kirchhoff's voltage law (KVL) in D.C. circuits
2.	To verify Kirchhoff's current law (KCL) in D.C. circuits
3.	To verify Superposition theorem in DC circuits.
4.	To verify Thevenin's theorem in DC circuits
5.	To verify Norton's theorem in DC circuits '
6.	To verify Maximum Power Transfer theorem in DC circuits.
7.	Study of PN junction diode and its characteristics
8.	Study of ZENER junction diode and its characteristics
9.	Study of half wave rectifier with and without capacitive filter
10.	Study of full wave rectifier with and without capacitive filter
11.	Study of BJT in CB /CE configuration
12.	Verification of basic and derived gates.
13.	Realization of basic gates through universal gates.

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

Name of Department: - Nursing

1. Subject Code: **THF101/201** Course Title: **Healthy Living and Fitness**
2. Contact Hours: **L:** 2 **T**: 0 **C**: 0
3. Examination Duration (Hrs): **Theory** 3 **Practical** 0
4. Relative Weight: **CIE** -- **MSE** -- **ESE** 100
5. Credits: 2
6. Semester: 2
7. Category of Course: **VAC/MNG**
8. Pre-requisite: NIL

9.**Course Outcome:**	After completion of the course the students will be able to**:** CO1: Explain the importance of balanced food and proper diet in daily life CO2:Recognize the benefits of healthy lifestyle, lifestyle management, and related diseases CO3: State the problems related to addiction and benefits of routine exercises. CO4:Describe the significance of mental health and keys to stress management CO5: Express the benefits of yoga and meditation

10. **Details of the Course:**

Sl. No.	Contents	Contact Hours
1	**Unit 1:** **Human Body:** Awareness of important body organs, their location, and broad functions.	10

	Diet and Health: Importance of breakfast, fruits, whole grains Knowledge about constituents of diet. Importance of fiber. Harmful effects of junk/processed foods	
2	**Unit 2:** **Lifestyle Diseases and management:** Dangers of obesity, Diseases ensuing because of lifestyle e.g., Diabetes-Hypertension - Obesity- CHD. **Addictions and treatments:** Chewing/unhealthy harmful products, Drinking, Smoking: lethality's and management	10
3	**Unit 3:** **Importance of Mental Health:** Stress management, Anxiety and depression, Awareness of commonly encountered diseases/ailments. **Yoga and Stress Management:** Benefits of yogic exercises and meditation for physical and mental fitness, stress management and relaxation techniques	10
	Total	**30**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Darshan Sohi	A Comprehensive Textbook of Applied Nutrition and Dietetics for BSc Nursing Students	Third	Jaypee ,India	2022
Leon Beach	Yoga and Meditation: Alternative Medicine	First	Larsen and Keller Education (21 April 2017)	2017
Tim Spector	Food for Life: The New Science of Eating Well	First	Jonathan Cape	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Mr. Rahul Kushwah, Mr. Shrikant& Mr. Yogendra Kushwah	Fundamental of Yogic Practices (A Complete Guide of Yoga)	First	Khel Sahitya Kendra (1 January 2021)	2021
Anita Jatana	Apollo Clinical Nutrition Handbook	First	Jaypee brothers medical publishers	2022
N. Shakuntala Manay & M. Shadaksharaswamy	New Age Foods Facts And Principles	Fifth	New age international publishers	2023

Department of Mechanical Engineering						
Program: - Bachelor of Technology (Common to all the Programs)						
Semester	I / II	***Course Title***	**Mechanical Workshop &Manufacturing Practices**		***Code*** PME 151/25 1	**ESC**
Course Components		***Credits***	***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		02		00	00	04
Examination Duration (Hrs)		***Theory*** / ***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00 / 04		25	25	50
Pre-requisite	NIL					

COURSE OBJECTIVE(S): The objective of this Course is to provide new ways of creative thinking and to learn the innovation cycle of Manufacturing processes for developing innovative products, which are useful for
students in preparing for an engineering career.

Course Outcomes		
CO1	Identify various conventional, non-conventional and automated manufacturing techniques.	
CO2	Explain various manufacturing practices used for the production of work pieces and different innovative products in shops like Machine, Welding, Casting, Carpentry, Advanced manufacturing methods, e.g. CNC router, 3D Printer, Laser Cutting, Arduino	
CO3	Apply the principles of manufacturing in developing different creative products using a CNC router, 3D Printer, Laser Cutting, and Arduino.	
CO4	Analyse the different properties of various materials used for making products.	
	List of Practicals	***Contact Hours***
	Week 1: Introduction of manufacturing, 3M's of manufacturing: man, machine and material. Types of manufacturing processes, followed by visits to all shops	4
	Week 2: Machine Shop 1. To make a work piece of mild steel using Facing, Turning and Threading operations	4
	Week 3: Foundry Shop 2. To prepare a mould casting using silicone rubber and perform polymer casting using epoxy resin and hardener in a ratio of 2:1.	4
	Week 4: Fitting Shop 3. To prepare a square piece of mild steel of the given dimensions.	4
	Week 5: 3-D printing 4. To 3D print an object using PLA filament by preparing a model, slicing it, and analysing the print quality.	4

	Week 6: Welding Shop **5**. To prepare a butt(single –V) joint using electric arc welding	4
	Week 7,8: Carpentry Shop **6.** To make a corner Lap joint/Centre Lap joint of soft wood. **7.** To prepare a model using the CNC router to cut a wooden block by designing a tool path, setting machine parameters	8
	Week 9,10 : Non-Conventional and Automated Manufacturing Techniques **8.**To write and upload an Arduino program that makes an LED blink at regular intervals using the digital output pin of an Arduino UNO board. **9.** To interface an ultrasonic sensor (HC-SR04) with a servo motor using Arduino UNO and program the system to rotate the servo based on the measured distance to an object**.**	8
	Week 11: Laser Machining **10.** To understand and perform Laser engraving and cutting operations on MDF (Medium Density Fibreboard) using a laser cutting machine, by designing, setting appropriate parameters(power, speed, frequency).	4
	Week 12: Mini project **To submit a project using the above manufacturing techniques**	**4**
	Total Hours	48

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
A.K..Hajra Chaudhary& S.K Hajra Chaudhary	Workshop Technology Vo I & II	15th	Media Publishing House	2020
R C S Mehta, NS Gaira & Y Chaudhary	Manufacturing Science & Technology -I	1st	SPORE	2018
P C Sharma	A Text Book of Production Technology	7th	S.Chand	2019

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
B.L.Juneja	Workshop&Manufacturing Practices	Ist Impression	CENGAGE	2019
Seropo Kalpakjian& Steven R Schimid	Manufacturing Engineering and Technology	7th	PEARSON	2020
R S Raghuwanshi	Workshop Technology	10th	Dhanpat Rai&Sons	2018

Department of Mechanical Engineering							
Program: - Bachelor of Technology (Common to all the Programs)							
Semester	I / II	***Course Title***	**Design Thinking**			***Code***	**HSMC101/201**
Course Components		***Credits***	***Contact Hours***		***L***	***T***	***P***
VAC/ESC		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CWA***	***MSE***	***ESE***
		00	02		25	25	50
Pre-requisite	NIL						
COURSE OBJECTIVE(S): The objective of this Course is to provide the new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.							
Course Outcomes							
CO1	Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products						
CO2	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products						
CO3	Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development						
CO4	Implementing design thinking in the real world and create a better customer experience.						
Unit No.	***Content***						***Contact Hours***
Unit -1	**Introduction to Design thinking** Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques Emotions: Experience & Expression						2
Unit -2	**Basics of Design Thinking** Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test						10
Unit -3	**Process of Product Design** Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem-Solving, Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Product design with AI. Assignment – Engineering Product Design						6
Unit -4	**Celebrating the Difference** Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences						2

Unit -5	**Design Thinking & Customer Centricity** Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design.	2

Unit -6	**Project** Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution". **This will be a Group activity and the project will be assigned by mentor.**	8
	Total Hours	30

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
E Balaguruswamy	Developing Thinking Skills (The way to Success)	32nd edition	Khanna Book Publishing Company, India	2022
Bala Ramadurai	Karmic Design Thinking	1st	Self-Published	2020

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).	Solving Problems with Design Thinking Ten Stories of What Works	1st	(Columbia Business School Publishing)	2013
Yousef Haik and Tamer M.Shahin	Engineering Design Process	2nd	Cengage Learning	2011
Karen Gadd	TRIZ For Engineers: Enabling Inventive Problem Solving	1st	John Wiley & Sons	2011

Department of Mechanical Engineering								
Program: - Bachelor of Technology (Common to all the Programs)								
Semester	I / II	***Course Title***		**Engineering Graphics and Design**		***Code***	**PME 153/253**	
Course Components		***Credits***		***Contact Hours***		***L***	***T***	***P***
SEC		02				00	00	04
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***		***CWA***	***MSE***	***ESE***
		00	03			25	25	50
Pre-requisite	NIL							
Course Outcomes								
CO1	Construct Engineering Drawings as per BIS conventions manually and using CAD software to prepare Orthographic Projections of Points and Lines.							
CO2	Use the knowledge of Orthographic Projections to represent Engineering concepts of Planes.							
CO3	Develop Projections of Solids and Lateral Surfaces of Solids by analysing the given problems.							
CO4	Construct Isometric Drawings after analysing the combination of simple solids.							
Unit No.	***Content***							***Contact Hours***
Unit -1	**Introduction to Computer Aided Sketching:** Introduction, Drawing Instruments and their uses, BIS conventions, lettering, Dimensioning and free hand practicing. Computer screen, layout of the software, standard tool bar, and description of most commonly used tool bars, navigational tools. Coordinate system and reference planes. Definitions of HP, VP, RPP& LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of lines, Coordinate points, axes, poly-lines, square, rectangle, polygons, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line convention, material conventions and lettering. Computer Aided Design(CAD) software: Modelling of parts and Assemblies.							8
Unit -2	**Orthographic projections of Points, Lines and Planes:** Introduction, Definitions - Planes of projection, reference line and conventions employed. First angle and Third angle projection. Projections of Points in all the four quadrants. Projection of Lines (located in first quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems) Projection of Planes: triangle, square, rectangle, pentagon, hexagon, and circle, Planes in different positions by change of position method only (No problems on punched plates and composite plates.)							20
Unit -3	**Projections of Solids:** Projections of right regular Prisms, Pyramids and Cones with axis inclined to both the planes. (Solids resting on HP only)							8

Unit -4	**Development of Lateral Surfaces of Solids:** Sections of right regular prisms, Pyramids, Cylinders and Cones resting with base on HP. Development of lateral surfaces of above solids, their truncations.	8
Unit -5	**Isometric Projections:** Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions, Isometric views of Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice - Versa.	8
Unit -6	**Demonstration of a Simple Team Design Project that Illustrates:** Geometry and topology of Engineered components: creation of Engineering models and their presentation in standard 2D blueprint form and as 3D wireframe and shaded solids; meshed topologies for Engineering analysis and tool-path generation for component manufacture; Geometric Dimensioning and Tolerancing; Use of Solid-Modelling software for creating associative models at the component and assembly levels.	8
	Total Hours	60

CAD Softwares:	1. **AUTOCAD** 2. **CREO**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
K.R. Gopalakrishna	Engineering Graphics	32nd edition	Subash Publishers, Bangalore.	2005
S.Trymbaka Murthy	Computer Aided Engineering Drawing	3rd revised edition.	International Publishing house Pvt. Ltd., New Delhi,	2006

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
N.D. Bhatt and V.M. Panchal	Engineering Drawing	48th edition	Charotar publishing House, Gujarat.	2005

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I/II

Name of Department: - Civil Engineering

Course Code:		**PCE151/251**	**Course Title:**	**Basic Civil Engineering Laboratory**	
Credits:	1	**Semester:**	I/II	**Category of Course:**	DSC

TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	15	**CIE**	**MSE**	**ESE**
0	0	2		25	25	50

Examination Duration (Hrs):	**Theory**	**Practical**
	0	3

Pre-requisite:

Course Outcome:	After completion of the course the students will be able to**:** CO1: Perform field and laboratory tests on construction materials including bricks, cement, fine aggregate, mortar, concrete and reinforcing steel (TMT & M.S. bars), and evaluate their engineering properties. CO2: Construct masonry bonds, cast and test plain cement concrete, and determine the mechanical properties of reinforcing steel through tensile, bend and re-bend tests. CO3: Conduct linear and angular measurements using chain, tape, cross staff, compass, theodolite. CO4: Demonstrate the application of modern surveying and geomatics technologies, including EDM, Total Station, GPS, and GIS.

Details of the Course:

Sl. No.	Contents	Contact Hours
1	**Construction Materials and Material Testing** Introduction to basic construction materials like bricks, cement and its type, sand and mortar. 1. Test on Bricks: Field Test and Water Absorption Test. 2. Tests on Cement: Field Test and Compressive Strength Test. 3. Test on Fine Aggregate :(Particle Size Classification of Sand using Sieve Analysis), Silt content test 4. Construct a Wall using English and Flemish Bond. 5. Casting and Testing of Plain Cement Concrete. 6. Behavior of TMT & M.S. Bars under Tension. Plot the Stress–Strain Curve and determine the Modulus of Elasticity (Young's Modulus, E). 7. Bend Test and Re-bend Test on TMT Reinforcement Bars.	8
2	**Surveying and Geomatics** **Introduction to linear measurements (Chain and Tape survey):** Different methods of linear measurement and their accuracy; Measurement by chain and tape; Sources of errors and precautions; Corrections to linear measurements. 8. Chaining of a line using chain and tape, measurements of area by cross staff survey. 9. Measurement of distance between two points when there is an obstacle for both chaining and ranging. **Measurements of angles and directions (Compass & Theodolite survey):** Demonstration of different types of compasses and theodolites; Concept of bearings; Magnetic declination; Traverse survey. 10. To measure the angles between the lines with prismatic Compass. 11. Traversing with compass and chain by included angles and measurement of area -Plotting the points (at scale) on a graph sheet. 12. To measure the horizontal and vertical angles with Theodolite **Modern tools and instruments for surveying and mapping:** Introduction to Remote Sensing, GPS and GIS. 13. Demonstration of distance and angle measurements using an EDM	7

	and Total Station Using Handheld GPS and mobile GIS for data collection	
	Total	**15**

Text Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
M.S. Shetty and A.K. Jain	Concrete Technology: Theory and Practice	8th	S. Chand Publishing, India	2018
B.C. Punmia, Ashok K. Jain, Arun K. Jain	Surveying (Vol. 1)	17th	Laxmi Publications, India	2016
S.K. Duggal	Surveying (Vol. 1 & 2)	5th	McGraw Hill Education, India	2019

Reference Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
M.L. Gambhir and Neha Jamwal	Building Materials: Products, Properties and Systems	1st	McGraw Hill Education, India	2017
A.M. Chandra	Higher Surveying	4th	New Age International, India	2023
B.C. Punmia, Ashok K. Jain, Arun K. Jain	Building Construction	12th	Laxmi Publications, India	2026

Note: The detailed activity plans for Term Work (TW) and Self-Learning (SL) components are provided in the Course Handout

2026-27 onwards

DEPARTMENT OF ALLIED SCIENCES (PHYSICS)

SEMESTER I/II

Course Code:		TPH101/201		Course Title:		Engineering Physics		
Credits:	3	Semester:	I/II	Category of Course:		DSC		
TEACHING PERIODS (In hours per week)			TW+SL (in hours per semester)		Relative Weight			
L	T	P	45		CIE	MSE	ESE	
3	0	0			25	25	50	
Examination Duration (Hrs):			Theory		Practical			
			3		0			

Pre-requisite: Basic Knowledge of Physics

Course Outcome:	**After completion of the course, the students will be able to:** **CO1**: Explain interference, diffraction, and polarization in wave optics, from everyday phenomena to applications in photonic and quantum computing. **CO2**: Apply the principles of lasers, fiber optics, and wave phenomena to analyze engineering and communication technologies, and use relativistic mechanics to explain relativistic effects. **CO3**: Analyze relativistic effects using the fundamental concepts of the special theory of relativity. **CO4**: Evaluate the applications of quantum theory, Schrödinger wave mechanics and Maxwell's equations for solving related problems, along with the fundamentals of quantum computing. **CO5**: Integrate concepts of superconductivity in quantum computing, electromagnetic principles, and nanomaterials to develop engineering solutions for emerging technological applications.

10. **Details of the Course:**

S.No.	CONTENTS	Contact Hrs
1.	**UNIT-1: Wave Phenomena: From Classical Wave Optics to Photonic Computing Applications** **Interference:** Conditions of interference, Spatial and temporal coherence, Bi-prism, interference in wedge-shaped film, Newton's rings. **Diffraction:** Fraunhofer diffraction at a single slit and n-slits (Diffraction Grating). Rayleigh's criteria of resolution. Resolving power of grating.	9
2.	**UNIT-2: Optical Technologies in Quantum Computing**	9

	Polarization: Basic theory of double refraction, Malus law, Ordinary and Extra-ordinary ray, Production, and detection of plane, elliptically and circularly polarized light, specific rotation and polarimeters. **Laser:** Spontaneous and Stimulated emission of radiation, Einstein Coefficients, Principle of laser action. Construction and working of Ruby and He-Ne laser photovoltaic effect. **Fiber Optics:** Introduction to fiber optics; types of fiber, acceptance angle and cone angle, numerical aperture.	
3.	**UNIT-3: Concepts of Space, Time, and Energy:** **Special theory of relativity:** Inertial and non-inertial frames, Galilean transformation, Michelson-Morley experiment (qualitatively), Einstein postulates of special theory of relativity, Lorentz transformation equations, length contraction, time dilation, variation of mass with velocity, mass-energy relation.	**8**
4.	**UNIT-4: Quantum Mechanics and Quantum Computing Basics:** **Quantum Mechanics:** Quantum concept and radiation, Wave particle duality (de-Broglie concept of matter waves), Heisenberg's uncertainty principle, wave function and its significance, Schrodinger's equations, Schrodinger's wave function for a particle confined in one-dimensional infinite potential box (rigid box), Eigen values and Eigen functions. **Quantum computers:** Introduction: Principles, qubits, quantum logic, states, quantum gates, mathematical representation of states and gates, prospects and challenges.	**8**
5.	**UNIT-5: Fundamentals of Superconducting Quantum Computers, EM Theory and Nano Physics** **Superconductivity:** Essential properties of superconductors, zero resistivity, Type I, Type II superconductors and their properties. **Electromagnetism:** Displacement current, Maxwell's Equations in differential form. **Nano Physics**: Density of states, Nanostructures, fabrication, and characterization techniques (qualitatively).	**8**
	Total	**42**

Text Books:

Authors	**Title**	**Edition**	**Publisher, Country**	**Year**
Ajoy Ghatak	Optics	4th Edition	Tata McGraw Hill, India	2009
N. Subrahmanyam, Brijlal & M. N. Avadhanulu	Optics	24th Edition	S. Chand, India	2010
Arthur Beiser	Concepts of Modern Physics	1st Edition	Tata McGraw Hill, India	—
Resnick, Halliday & Krane	Physics (Vol. I & II)	5th Edition	Wiley, USA	2007
Robert Resnick	Introduction to Special Relativity	1st Edition	Wiley, USA	2007

N. David Mermin	Quantum Computer Science	1st Edition	Cambridge University Press, UK	2007
Adam Smith	The Beginner's Guide to Quantum Computing & Mechanics	1st Edition	A. Smith Media, USA	2022

Reference Books:

Authors	**Title**	**Edition**	**Publisher, Country**	**Year**
John R. Taylor, Chris D. Zafiratos, Michael A. Dubson	Modern Physics	1st Edition	Pearson Education, USA	2007
Gerd Keiser	Optic Fiber Communication	5th Edition	Tata McGraw Hill, India	2017
Alastair I. M. Rae, Jim Napolitano	Quantum Mechanics	6th Edition	Wiley, USA	2015
David J. Griffiths	Introduction to Electrodynamics	3rd Edition	Prentice Hall, USA	2011
Charles P. Poole Jr., Frank J. Owens	Introduction to Nanotechnology	Wiley, USA	2017	
Hugh D. Young & Roger A. Freedman	University Physics	12th Edition	Pearson Publications, USA	2008
Alan Giambattista, Betty McCarthy Richardson, Robert C. Richardson	Fundamentals of Physics	1st Edition	Tata McGraw Hill, India	2009
Parag Lala	Quantum Computing	1st Edition	Tata McGraw Hill, India	2019
Michael A. Nielsen & Isaac L. Chuang	Quantum Computation and Quantum Information	1st Edition	Cambridge University Press, UK	2007

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Semester I/II

Name of Department: - Allied Sciences (Physics)

Course Code:		**PPH 151/251**		**Course Title:**		**Physics Lab**		
Credits:	1	**Semester:**	I/II	**Category of Course:**		DSC		
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**		**Relative Weight**			
L	**T**	**P**	15		**PRS**	**MSE**	**ESE**	
0	0	2			25	25	50	
Examination Duration (Hrs):			**Theory**		**Practical**			
			0		2			

Pre-requisite: Basic Knowledge of Experiments in Physics

Course Outcome:	**After completion of the course the students will be able to:** CO1: Find the electrical properties of materials and magnetic field variation of circular coil, also extend the knowledge of nanotechnology using electroplating. CO2: Understand the nature of polarized light and characteristics of photo devices and optical fiber. CO3: Apply the methods of calibration to analog instruments. CO4: Determine the refractive index of liquid, wavelength of light, and specific rotation of optically active substance through experiments based on phenomena of optics.

Details of the Course:

Sl. No.	**Contents**	**Contact Hours**
	Students have to perform any twelve experiments: 1. To determine the wavelength of monochromatic light by Newton's ring experiment. 2. To determine refractive index of transparent liquid by Newton's ring experiment. 3. To determine the specific resistance of the constantan wire using Carey-Foster's bridge. 4. To determine the wavelength of monochromatic light using Fresnel Biprism experiment	2

	5. To determine the energy band gap of given semiconductor by Four-probe method. 6. (a) To determine the wavelengths of spectral line of Mercury light using plane transmission grating. (b) To determine the wavelengths of given Laser light using plane transmission grating. 7. To study the variation of magnetic field with distance along the axis of circular coil carrying current and to determine the radius of coil. 8. To determine the magnetic susceptibility of a paramagnetic substance by Quincke's method. 9. To determine the specific rotation of Sugar Solution using Half Shade Polarimeter. 10. To study the characteristics of Solar Cell 11. a) To calibrate Voltmeter by using potentiometer. b) To calibrate Ammeter by using potentiometer. 12. To determine Planck's constant by photoelectric method and study the variation of intensity with distance. 13. To determine the electro chemical equivalent of Copper. 14. To Verify Law of Malus. 15. To study Hall Effect and determine the hall voltage, hall coefficient, current density and carrier mobility of a given semiconductor. 16. To determine the numerical aperture and acceptance angle of an optical fiber. 17. To measure the refractive index of transparent liquid using Laser. 18. To determine the dielectric constant of air/slab. 19. To determine wavelength of monochromatic light using Michelson interferometer.	

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I

Name of Department: - Biotechnology

Course Code:		**TBT103**	**Course Title:**	**Introduction to Bioengineering**		
Credits:	3	**Semester:**	I	**Category of Course:**	SEC/BSC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	45	**CIE**	**MSE**	**ESE**
3	0	0		25	25	50
Examination Duration (Hrs)			**Theory**		**Practical**	
			3		0	

Pre-requisite Courses: Basic knowledge of Biology

Course Outcome:	After completion of the course the students will be able to**:** CO1: Explain the fundamental concepts, interdisciplinary nature, biological systems, biomolecules, and core principles of bioengineering and biotechnology. CO2: Apply fundamental knowledge of biological systems and engineering principles to explain the role of biotechnology in healthcare, agriculture, food, industrial production, and environmental sustainability. CO3: Analyze the applications of microorganisms, biomolecules, bioprocesses, and modern biotechnological tools in solving real-world biological and engineering problems. CO4: Analyze the principles and applications of emerging technologies including bioinformatics, artificial intelligence, nanobiotechnology, synthetic biology, genome editing, biomedical engineering, and omics technologies. CO5: Evaluate the ethical, biosafety, regulatory, intellectual property, sustainability, and entrepreneurial aspects involved in biotechnology research, products, and innovations. CO6: Design innovative biotechnology-based concepts or solutions by integrating

	fundamental biological knowledge, engineering principles, emerging technologies, and sustainable practices to address societal and industrial challenges.

Details of the Course:

Sl. No.	Contents	Contact Hours
1	**Unit-A: Fundamentals of Bioengineering and Biotechnology:** Introduction to bioengineering and biotechnology; Historical development and evolution of biotechnology; Interdisciplinary nature and branches of biotechnology; relationship between biology and engineering; scope and significance of biotechnology; Applications in healthcare, agriculture, food, industry and environment; Biotechnology for sustainable development; Biotechnology industries and bioeconomy; Overview of bioprocesses and future prospects.	**10**
2	**Unit-B: Biological Systems and Biomolecules:** Characteristics and organization of living systems; prokaryotic and eukaryotic cells; cell structure and functions; introduction to microorganisms; biomolecules including carbohydrates, proteins, lipids and nucleic acids; enzymes and their significance; DNA, RNA, genes and the central dogma of molecular biology; basics of metabolism and bioenergetics.	**10**
3	**Unit-C: Applications of Biotechnology:** Applications of biotechnology in medicine, agriculture, food, industry and environmental management; vaccines, recombinant therapeutics, molecular diagnostics, plant tissue culture, genetically modified crops, biofertilizers, fermented foods, industrial enzymes, biopharmaceuticals, biofuels, bioplastics, bioremediation, wastewater treatment, circular bioeconomy, and selected case studies of biotechnology innovations.	**9**
4	**Unit-D: Emerging Areas of Bioengineering:** Introduction to bioinformatics and computational biology; artificial intelligence and machine learning in biotechnology; nanobiotechnology; biosensors; synthetic biology; genome editing (CRISPR overview); omics technologies; tissue engineering; regenerative medicine; biomedical engineering; organ-on-chip technology;	**8**

	recent advances and future trends in biotechnology.	
5	**Unit-E: Bioethics, Biosafety and Entrepreneurship:** Principles of biosafety and laboratory safety; bioethics; intellectual property rights; regulatory agencies related to biotechnology; innovation and entrepreneurship; biotechnology startups and incubation; commercialization of biotechnology products; Sustainable Development Goals (SDGs); career opportunities and future challenges in biotechnology.	**8**
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
William J. Thieman and Michael A. Palladino	Introduction to Biotechnology	4th	Pearson Education, USA	2019
Bernard R. Glick, Jack J. Pasternak and Cheryl L. Patten	Molecular Biotechnology: Principles and Applications of Recombinant DNA	5th	ASM Press, USA	2022
B. D. Singh	Biotechnology: Expanding Horizons	5th	Kalyani Publishers, India	2023

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
David P. Clark and Nanette J. Pazdernik	Biotechnology: Applying the Genetic Revolution	2nd	Academic Cell, USA	2016
David L. Nelson and Michael M. Cox	Lehninger Principles of Biochemistry	8th	W. H. Freeman, USA	2021
Bruce Alberts, Rebecca Heald, Alexander Johnson, David Morgan, Martin Raff, Keith Roberts and Peter Walter	Molecular Biology of the Cell	7th	Garland Science, USA	2022

Note: The detailed activity plans for Term Work (TW) and Self-Learning (SL) components are provided in the Course Handout.

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
TBT103.1	Explain the fundamental concepts, interdisciplinary nature, biological systems, biomolecules, and core principles of bioengineering and biotechnology.	3	2	–	–	1	–	–	–	1	–	2	3	1	–
TBT103.2	Apply fundamental knowledge of biological systems and engineering principles to explain the role of biotechnology in healthcare, agriculture, food, industrial production, and environmental sustainability.	3	3	2	–	2	3	–	–	1	–	2	3	3	1
TBT103.3	Analyze the applications of microorganisms, biomolecules, bioprocesses, and modern biotechnological tools in solving real-world biological and engineering problems.	2	3	3	2	3	2	–	1	1	–	2	3	3	1
TBT103.4	Analyze the principles and applications of emerging technologies including bioinformatics, artificial intelligence, nanobiotechnology, synthetic biology, genome editing, biomedical engineering, and omics technologies.	2	3	2	2	3	2	–	–	1	–	3	2	3	–

TBT103.5	Evaluate the ethical, biosafety, regulatory, intellectual property, sustainability, and entrepreneurial aspects involved in biotechnology research, products, and innovations.	1	2	1	–	–	3	3	1	2	1	2	2	1	3
TBT103.6	Design innovative biotechnology-based concepts or solutions by integrating fundamental biological knowledge, engineering principles, emerging technologies, and sustainable practices to address societal and industrial challenges.	2	3	3	2	3	3	2	2	2	3	3	3	3	3
TOTAL		2.16	2.66	2.2	2	2.4	2.6	2.5	1.33	1.33	2	2.33	2.66	2.33	2

Note: The correlation levels are defined as follows: 3 (Substantial), 2 (Moderate), and 1 (Slight). A dash ("-") indicates that the course outcome does not contribute to the respective Program Outcome (PO) or Program Specific Outcome (PSO).

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER II

Name of Department: - Biotechnology

Course Code:		**TBT202**	**Course Title:**		**Medical Biotechnology and Healthcare Applications**		
Credits:	3	**Semester:**	II	**Category of Course:**	SEC/BSC		
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**		**Relative Weight**		
L	**T**	**P**	45		**CIE**	**MSE**	**ESE**
3	0	0			25	25	50
Examination Duration (Hrs)			**Theory**		**Practical**		
			3		0		

Pre-requisite Courses: Introduction to Bioengineering (TBT103)

Course Outcome:	After completion of the course the students will be able to**:** CO1: Recall the fundamental concepts of pathogenic microorganisms, immunology, laboratory management, quality control, and medical biotechnology. CO2: Explain the pathogenicity, diagnosis, immune responses, and biotechnological applications of infectious diseases. CO3: Apply microbiological, immunological, and laboratory techniques for the diagnosis, prevention, and management of infectious diseases. CO4: Analyze host–pathogen interactions, laboratory findings, quality control measures, and biotechnology-based diagnostic approaches. CO5: Evaluate diagnostic methods, infection control strategies, vaccines, therapeutic products, and quality management practices in medical biotechnology. CO6: Design biotechnology-based solutions for the diagnosis, prevention, and management of infectious diseases using modern medical biotechnology approaches.

Details of the Course:

Sl. No.	Contents	Contact Hours
1	**Unit 1: Commensal & Pathogenic Bacteria:** Normal microflora of human body: Skin, Respiratory system and Genitourinary tracts. Source of infection, mode of spread and portals of entry. Common pathogenic bacteria: Introduction of pathogenicity determinants- bacterial cell wall, flagella, capsule. Characterization, pathogenicity, lab diagnosis, prophylaxis of *Staphylococcus, Streptococcus, Bacillus, Clostridium*	10
2	**Unit 2: Introduction to Pathogenic Fungi & Viruses:** Fungi: Introduction to morphology, symptoms, lab diagnosis and prevention of Mycoses. **Viruses:** General morphology, properties, cultivation techniques for virus cultivation. Pathogenicity, prophylaxis, Diagnosis of medically important viruses: Polio viruses, Rabies viruses, Human immunodeficiency viruses, COVID -19 viruses.	8
3	**Unit 3: Immunology: Components of Immune system:** Types of Immunity, barriers of natural immunity, cells and organs of Immune system, properties of antigen and antibody, Types of antibodies and their significance in host-pathogen interaction. Antigen and Antibody Interactions-Bacterial agglutination.	10
4	**Unit 4: Management and Quality Control of Medical Biotechnology Laboratory: Specimen Collection**: Collection of clinical specimens from patients, clinics, hospitals, for diagnosis and processing, Quality Control: Selective cultural media, and sero-typing of pathogenic bacteria. Antibiotic susceptibility testing, its interpretation and reporting. Hospital infection control: Quality control in diagnostic microbiology, National programmer for control of infectious diseases.	10
5	**Unit 5: Applications of Medical Biotechnology: Tools and techniques**: Hybridoma technology, biopharming-subunit vaccines, DNA vaccines, recombinant vaccines, therapeutic enzymes, Insulin production.	8
	Total	**45**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Dr Reba Kanungo	Ananthanarayan and Paniker's Textbook of	10th	The Orient Blackswan	2017

	Microbiology			
S. ThyagaRajan, Dr. N. Selvamurugan, M.P. Rajesh, R.A. Nazeer, Jaganathan.M.K Richard W. Thilagaraj, S. Barathi	Biology for Engineers.	1st	McGraw Hill	2019
B. D. Singh	Biotechnology: Expanding Horizons	5th	Kalyani Publishers, India	2023

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Berdell R. Funke Gerard J. Tortora	Microbiology: An Introduction	8th edition	Pearson/Benjamin Cummings	2004
Apurba Sastry	Essentials of Medical Microbiology	4th Edition	Jaypee Brothers Medical Publishers	2023
Sharon Stranford, Owen Judy, Jones Patricia, Punt Jenni	Kuby Immunology	8th	SPRINGER 35	2022

Note: The detailed activity plans for Term Work (TW) and Self-Learning (SL) components are provided in the Course Handout.

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
TBT202.1	Recall the fundamental concepts of pathogenic microorganisms, immunology, laboratory management, quality control, and medical biotechnology.	3	2	–	–	1	1	–	–	1	–	2	3	2	–
TBT202.2	Explain the pathogenicity, diagnosis, immune responses, and biotechnological applications of infectious diseases.	3	3	2	1	2	2	1	–	1	–	2	3	3	1
TBT202.3	Apply microbiological, immunological, and laboratory techniques for the diagnosis, prevention, and management of infectious diseases.	3	3	3	2	3	2	1	1	1	–	2	3	3	1
TBT202.4	Analyze host–pathogen interactions, laboratory findings, quality control measures, and biotechnology-based diagnostic approaches.	2	3	2	3	3	2	1	1	1	–	3	3	3	1
TBT202.5	Evaluate diagnostic methods, infection control strategies, vaccines, therapeutic products, and quality management practices in medical biotechnology.	2	3	2	2	2	3	3	1	2	1	2	3	2	3
TBT202.6	Design biotechnology-based solutions for the diagnosis, prevention, and management of infectious diseases using modern medical	3	3	3	3	3	3	2	2	2	3	3	3	3	3

	biotechnology approaches.														
TOTAL		2.66	2.83	2.4	2.2	2.33	2.16	1.6	1.25	1.33	2	2.33	3	2.66	1.8

Note: The correlation levels are defined as follows: 3 (Substantial), 2 (Moderate), and 1 (Slight). A dash ("-") indicates that the course outcome does not contribute to the respective Program Outcome (PO) or Program Specific Outcome (PSO).

GRAPHIC ERA (DEEMED TO BE UNIVERSITY), DEHRADUN

SEMESTER I

Name of Department: - Biotechnology

Course Code:		**PBT102**	**Course Title:**	**Bioengineering Lab**		
Credits:	1	**Semester:**	I	**Category of Course:**	SEC/LC	
TEACHING PERIODS (In hours per week)			**TW+SL (in hours per semester)**	**Relative Weight**		
L	**T**	**P**	15	**CIE**	**MSE**	**ESE**
0	0	2		25	25	50
Examination Duration (Hrs)			**Theory**		**Practical**	
					2	

Pre-requisite Courses: Basic knowledge of Buffers, Solutions, Molarity, Normality and Percent Solutions, DNA, RNA and Proteins

Course Outcome:	After completion of the course the students will be able to: CO1: Identify laboratory safety practices, biosafety guidelines, PPE, biomedical waste management, and common biotechnology laboratory equipment. CO2: Explain the principles of sterilization, aseptic techniques, laboratory solution preparation, culture media, and basic biotechnology instruments. CO3: Perform basic laboratory techniques including solution preparation, sterilization, microbial culture, staining, blood grouping, and microscopy using standard protocols. CO4: Analyze experimental observations from microbiological, hematological, molecular biology, and bioinformatics experiments. CO5: Evaluate laboratory procedures, experimental results, biosafety practices, and biological data while maintaining proper laboratory documentation and ethics. CO6: Design and present laboratory reports or simple biotechnology-based solutions by integrating laboratory skills and bioengineering concepts.

Details of the Course:

Sr. No.	Experiment	Hours
1	Introduction to bioengineering laboratory, laboratory safety, biosafety practices, personal protective equipment (PPE), good laboratory practices (GLP), and biomedical waste segregation.	2
2	Familiarization with common biotechnology laboratory equipment including micropipettes, centrifuge, pH meter, analytical balance, spectrophotometer, microscope, incubator, autoclave, and laminar airflow cabinet; calibration of micropipettes.	2
3	Preparation of laboratory reagents, solutions and buffers; calculations of molarity, normality, percentage solutions, and serial dilutions.	2
4	Demonstration and practice of aseptic techniques; sterilization methods including autoclaving, hot air oven, membrane filtration, and UV sterilization.	2
5	Preparation of nutrient media (Nutrient Agar/Nutrient Broth and Potato Dextrose Agar) and inoculation of bacterial and fungal cultures using aseptic techniques.	2
6	Observation and identification of microorganisms using simple staining, Gram staining, and microscopic examination.	2
7	Determination of blood group (ABO and Rh typing) using a standard teaching kit and preparation of a blood smear for microscopic observation.	3
8	Introduction to molecular biology and bioengineering tools through demonstrations of DNA isolation, PCR, agarose gel electrophoresis, and spectrophotometric estimation of DNA/protein.	2
9	Introduction to bioinformatics resources: retrieval of biological information from NCBI, UniProt, and PDB databases; basic sequence search using BLAST (demonstration).	2
10	Industrial and research exposure through virtual laboratory visits, case studies on biotechnology innovations, guest lectures, and student seminar/presentation on recent advances in bioengineering and biotechnology.	3
	Total	**30**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
P. Gunasekaran	Laboratory Manual in Microbiology	1st	New Age International	2012

			Publishers, India	
K. Wilson and J. Walker	Principles and Techniques of Biochemistry and Molecular Biology	8th	Cambridge University Press, UK	2018

Reference Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
Cappuccino, J. G. and Welsh, C. T.	Microbiology: A Laboratory Manual	12th	Pearson Education, USA	2023
Aneja, K. R.	Experiments in Microbiology, Plant Pathology and Biotechnology	5th	New Age International Publishers, India	2022
Daniel C. Harris	Quantitative Chemical Analysis	10th	W. H. Freeman, USA	2020

Note: The detailed activity plans for Term Work (TW) and Self-Learning (SL) components are provided in the Course Handout.

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
PBT102.1	Identify laboratory safety practices, biosafety guidelines, PPE, biomedical waste management, and common biotechnology laboratory equipment.	3	1	-	1	1	-	-	-	-	-	1	3	1	-
PBT102.2	Explain the principles of sterilization, aseptic techniques, laboratory solution preparation, culture media, and basic biotechnology instruments.	3	2	-	1	1	-	-	-	-	-	1	3	1	-
PBT102.3	Perform basic laboratory techniques including solution preparation, sterilization, microbial culture, staining, blood grouping, and microscopy using standard protocols.	3	2	1	3	3	-	-	-	-	-	1	3	2	1
PBT102.4	Analyze experimental observations from microbiological, hematological, molecular biology, and bioinformatics experiments.	3	3	2	3	3	1	-	-	-	-	2	3	3	1
PBT102.5	Evaluate laboratory procedures, experimental results, biosafety practices,	3	3	2	3	3	2	1	-	-	-	2	3	3	2

	and biological data while maintaining proper laboratory documentation and ethics.														
PBT102.6	Design and present laboratory reports or simple biotechnology-based solutions by integrating laboratory skills and bioengineering concepts.	3	3	3	3	3	2	1	-	-	-	2	3	3	3
TOTAL		3	2.333333	2	2.33	2.33	1.66	1	-	-	-	1.5	3	2.16	1.75

Note: The correlation levels are defined as follows: 3 (Substantial), 2 (Moderate), and 1 (Slight). A dash ("-") indicates that the course outcome does not contribute to the respective Program Outcome (PO) or Program Specific Outcome (PSO)

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DEPARTMENT OF ALLIED SCIENCES (CHEMISTRY)							
Semester	I/II	***Course Title***		Engineering Chemistry		***Code***	TCH101/201
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		03			03	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CIE***	***MSE***	***ESE***
		03	00		25	25	50

Course Outcomes	
CO1	Acquire knowledge of structure and properties of molecules based on bonding and spectroscopic techniques
CO2	Understand the chemistry of purification of water and its industrial and domestic application
CO3	Classify various types of polymers and their applications
CO4	Interpret and distinguish between the different types of conventional and non-conventional fuels
CO5	Apply the basic principles of electrochemistry in different electrochemical cells, corrosion control, fuel cells and industrial applications
Pre-requisite	Basic knowledge of Chemistry

Unit No.	***Content***	***Contact Hours***
Unit - I	**MOLECULAR STUCTURE AND SPECTROSCOPIC TECHNIQUES** Molecular Orbital Theory, Formation of homo and heteronuclear diatomic molecules, Hydrogen Bonding and its application Metallic Bonding (Band theory) and application to conductors, semiconductors and Insulators. Nanoscale Materials - Properties and applications Basic Principles of spectroscopy and its applications for molecular structure (UV-Vis and IR Spectroscopy)	**8**
Unit - II	**WATER TECHNOLOGY** Hardness of water: Causes, Types, Measurement, Boiler troubles: Sludges, Scales and Caustic Embrittlement Softening of water by L-S Process, Zeolite Process and Reverse Osmosis Process, Ion Exchange Process, Calgon Process Numerical Problems based on L-S Process, Zeolite Process and hardness of water.	**9**
Unit -III	**POLYMERS** **Polymers:** Definition, degree of polymerization, functionality of monomer, Classification of polymers with examples, Types of polymerizations – addition and condensation polymerization with examples. Average molecular (Mw, Mn) weight and its determination. **Plastics:** Definition and characteristics- thermoplastic and thermosetting plastics, preparation, properties, and applications of PVC and Bakelite **Fibers:** Characteristics of fibers – preparation, properties and applications of	**9**

	Nylon and Dacron. **Conducting polymers:** Characteristics, Classification and applications of conducting polymers with examples. **Biodegradable polymers:** Concept and advantages – Preparation of Polylactic acid and poly vinyl alcohol and their applications. **Liquid Crystalline Polymers:** Characteristics, classification with examples and their applications.	
Unit –IV	**FUELS** Fuels Definition, Classification and Characteristics of a good fuel, Calorific value and its determination by Bomb Calorimeter, Numerical problems on Bomb Calorimeter, Composition and uses of CNG, LPG and PNG. Biofuels as alternative sources of energy (biomass, biogas). Hydrogen fuel: physical and Chemical properties, colour classification	**7**
Unit-V	**ELECTROCHEMISTRY & ITS APPLICATIONS** Electrode potential, standard electrode potential, factors affecting the electrode potential of a cell. Nernst equation: Electrochemical series and its application, Electrochemical cell: Daniel cell, Concentration cells, electrolyte concentration cell Numerical problems based on electrode potential and emf of a cell. Corrosion its causes and effects, Theories of corrosion – Chemical & Electrochemical corrosion, Prevention of corrosion.	**7**
	Total	**40**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Sunita Rattan	Comprehensive Engineering Chemistry	2nd Edition	S.K. Kataria & Sons Delhi, India,	2009
Shashi Chawala	Theory and Practicals of Engineering Chemistry	3rd Edition	Dhanpat Rai and Company, India	2012
Jain & Jain	A text book of Engineering Chemistry	16th Edition	Dhanpat Rai Publishing Company, India	2018

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
K.N. Jayaveera, G.V.Subba Reddy, C. Ramachandraiah,	Chemistry for Engineers	1st Edition	McGraw Hill Higher Education Hyd.India	2009
L.E.Foster	Nanotechnology, Science Innovation & Opportunity	1st Edition	Prentice Hall, USA	2005
K. L. Kapoor	A text book of Physical Chemistry, Vol. 5	1st Edition	Macmillan, India	2004
F.W.Bill, Meyer	A Text book of Polymer Chemistry	3rd Edition		2009

DEPARTMENT OF ALLIED SCIENCES (CHEMISTRY)								
Semester	I/II	***Course Title***		Chemistry for Biotechnology		***Code***		TCH102/202
Course Components		***Credits***		***Contact Hours***	***L***	***T***		***P***
Core Course (CC)		03			03	00		00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CIE***	***MSE***		***ESE***
		03	00		25	25		50
Course Outcomes								
CO1	Understand the basic knowledge of different techniques of purification of organic compound							
CO2	Explain the reaction mechanism in organic chemistry.							
CO3	Illustrate concepts and knowledge on analytical and green chemistry and its application							
CO4	Learn and apply the concepts of analytical chemistry for sample analysis							
CO5	Discuss the knowledge of carbohydrates and their practical application to biotechnology and engineering.							
Pre-requisite	Basic knowledge of Analytical and Organic Chemistry							
Unit No.	***Content***							***Contact Hours***
Unit - I	**Analytical Chemistry: Basics and its applications** Definition of Qualitative and quantitative analysis, volumetric and gravimetric analysis, Principle of volumetric analysis. Concept of pH, buffer solution and Henderson equation. Concept of strength and concentration of solution, Normality, Molarity, Molality and interconversion of strength, Types of volumetric analysis**:** Acid-base, Complexometric, redox and precipitation titration (Principle and examples). **Green Chemistry** Twelve Principles of Green Chemistry, Adverse effects of chemicals, Practice of Green Chemistry.							**8**
Unit - II	**Water Chemistry** Physiochemical properties of water and measurements: pH, alkalinity, Hardness, types of hardness, conductivity, DO, BOD, COD, TDS. Softening of water by Lime- soda, zeolite, ion exchange, RO. Numerical based on Hardness, zeolite. Standards for purified water.							**7**
Unit - III	**Organic reactions and their mechanism** Nature of covalent bond and its orbital representation. Hybridization, bond energy, polarity of bond & dipole moment of molecules, Bond fission, Inductive effect, hyperconjugation, electromeric, resonance effects and their significance; Types of reagents: electrophiles & nucleophiles, Reaction intermediates: carbocation, carbanion, carbenes, and free radicals-generation, properties and stability, Addition reactions, Substitution reactions, Orientation in aromatic substitution reactions, Elimination reactions in organic chemistry.							**8**
Unit - IV	**Purification and spectroscopic determination of organic compounds** Crystallization, sublimation, Distillation and types (Fractional distillation, distillation under reduced pressure, Steam distillation) Extraction with solvent, Principle and applications. **Chromatography:** Introduction, principle & application of							**7**

	chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration. Basic Principle and applications of UV-Vis and IR spectroscopy.	
Unit - V	**Stereochemistry** Stereochemistry Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.	**7**
	Total	**40**

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Robert Thornoton Morrison, Robert Nailson Boyd, Saibal kanti Bhattacharjee	Organic Chemistry	7th Edition	Pearson education, United Kingdom	2010
I.L.Finar	Organic Chemistry, (Vol. I & II)	5th Edition	Pearson Publication, United Kingdom	2009
Arun Bahel, BS Bahel	Advanced Organic Chemistry	23rd Edition	S. Chand & Company Ltd.	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
F.W. Bill Meyer	Text book of Polymer Chemistry,	3rd Edition	W.J.Wiley India	2009
Joseph Lambert, Scott Gronert, Herbert Shurvell, David Lightner and Robert Graham Cooks	Organic Structural Spectroscopy	2nd Edition	Pearson Publication, United Kingdom	2013
Bernard Mille	Advanced Organic Chemistry	2nd Edition	Pearson Publication, United Kingdom	2003
L.E.Foster	Nanotechnology, Science Innovation & Opportunity	1st Edition	Prentice Hall, USA	2005

DEPARTMENT OF ALLIED SCIENCES (CHEMISTRY)							
Semester	I/II	***Course Title:*** Engineering Chemistry Lab			***Code:*** PCH151/251		
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE:***	***CIE***	***MSE***	***ESE***
		0	02	***EVALUATION***	25	25	50

Course Outcomes	
CO1	Analyze the water and oil quality parameter.
CO2	Understand the concept of viscosity, surface tension and their applications.
CO3	Analyze the ores and bleaching powder sample.
CO4	Knowledge of pH metric, potentiometric and calorimetry and their application in industry.
Pre-requisite	Basic Knowledge of Experiments in Chemistry

Experiment No.	***Content***	***Contact Hours***
EXP- 1	To determine the alkalinity of the given water sample containing carbonate (CO_3^{2-}) ions and bicarbonate (HCO_3^-) ions by titrating it against standard HCl solution [N/10] using phenolphthalein and methyl orange as indicators.	2
EXP - 2	Determination of cell constant and conductance of solutions.	2
EXP-3	To determine the temporary and permanent hardness of given water sample by titrating it against standard solution of M/100 Ethylene Diamine Tetracetic Acid (EDTA) using Eriochrome black-T (EBT) as an internal indicator.	2
EXP-4	To determine the coefficient of viscosity of the given sample solution by Ostwald's viscometer (Viscosity of water = 0.0101 Poise).	2
EXP-5	To determine the ferrous ion (Fe^{++}) content in given sample solution of Mohr's salt ($FeSO_4.(NH_4)_2SO_4.6H_2O$) by titrating it against standard N/30 potassium dichromate ($K_2Cr_2O_7$) solution by using potassium ferricyanide $K_3[Fe(CN)_6]$ as an external indicator.	2
EXP - 6	To determine the surface tension of the given sample solution by drop number method.	2
EXP - 7	To determine the percentage of available chlorine in the given sample of 1 gram bleaching powder by titrating it against standard solution of N/25 sodium thiosulphate ($Na_2S_2O_3$) using starch $(C_6H_{10}O_5)_n$ as an internal indicator.	2
EXP - 8	To determine the acid value of oil	2
EXP - 9	To determine the strength of unknown HCl solution by titrating it against N/10 NaOH solution with the help of pH meter.	2
EXP - 10	Synthesis of phenol-formaldehyde resin	2
EXP – 11	To determine the alkalinity of the given water sample containing carbonate (CO_3^{2-}) ions and hydroxide (OH^-) ions by titrating it against	2

	standard HCl solution [N/10] using phenolphthalein and methyl orange as indicators.	
EXP – 12	To determine the rate constant of a reaction	2
EXP – 13	To determine the Copper (Cu^{++}) ion content in the given sample of copper ore (blue vitriol) by titrating it against standard N/30 sodium thiosulphate solution using starch as indicator by Iodometric titration.	2
EXP - 14	Potentiometric - determination of redox potentials and EMF.	2

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Sunita Rattan	Comprehensive Engineering Chemistry	2nd Edition	S.K. Kataria & Sons Delhi, India,	2009
Shashi Chawala	Theory and Practicals of Engineering Chemistry	3rd Edition	Dhanpat Rai and Company, India	2012
B. Ramadevi and P. Aparna	Lab manual for Engineering chemistry	1st Edition	S Chand Publications, New Delhi	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
S.S. Dara	A text book on experiments and calculation in Engineering Chemistry	1st Edition	S Chand Publications, New Delhi, India	2008
G H Jeffery, J Bassett, J Mendham, R C Denney	Inorganic quantitative analysis, Vogel	4th Edition	Bath Press, Avon, united kingdom	1978

DEPARTMENT OF ALLIED SCIENCES (CHEMISTRY)							
Semester	I/II	***Course Title:*** Chemistry for Biotechnology Lab			***Code:*** PCH152/252		
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Core Course (CC)		01			00	00	02
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CIE***	***MSE***	***ESE***
		0	02		25	25	50

Course Outcomes	
CO1	Analyze the water and oil quality parameter.
CO2	Understand the concept of viscosity, surface tension and their applications.
CO3	Analyze the ores and bleaching powder sample.
CO4	Knowledge of pH metric, potentiometric and calorimetry and their application in industry.
Pre-requisite	Basic Knowledge of Experiments in Chemistry

Experiment No.	***Content***	***Contact Hours***
EXP- 1	To determine the alkalinity of the given water sample containing carbonate (CO_3^{2-}) ions and bicarbonate (HCO_3^-) ions by titrating it against standard HCl solution [N/10] using phenolphthalein and methyl orange as indicators.	2
EXP - 2	Chemical oscillations- Iodine clock reaction.	2
EXP-3	To determine the temporary and permanent hardness of given water sample by titrating it against standard solution of M/100 Ethylene Diamine Tetracetic Acid (EDTA) using Eriochrome black-T (EBT) as an internal indicator.	2
EXP-4	To determine the coefficient of viscosity of the given sample solution by Ostwald's viscometer (Viscosity of water = 0.0101 Poise).	2
EXP-5	To determine the ferrous ion (Fe^{++}) content in given sample solution of Mohr's salt ($FeSO_4.(NH_4)_2SO_4.6H_2O$) by titrating it against standard N/30 potassium dichromate ($K_2Cr_2O_7$) solution by using potassium ferricyanide $K_3[Fe(CN)_6]$ as an external indicator.	2
EXP - 6	To determine the surface tension of the given sample solution by drop number method.	2
EXP - 7	To determine the percentage of available chlorine in the given sample of 1 gram bleaching powder by titrating it against standard solution of N/25 sodium thiosulphate ($Na_2S_2O_3$) using starch $(C_6H_{10}O_5)_n$ as an internal indicator.	2
EXP - 8	To determine the acid value of oil	2
EXP - 9	To determine the strength of unknown HCl solution by titrating it against N/10 NaOH solution with the help of pH meter.	2
EXP - 10	Synthesis of a polymer/drug	2
EXP – 11	Determination of the partition coefficient of a substance between	2

	two immiscible liquids.	
EXP – 12	Paper Chromatography	2
EXP – 13	Determination of λ_{max} and preparation of calibration curve with the help of UV spectrophotometer.	2
EXP - 14	Determination of concentration using UV spectrophotometer	2

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Sunita Rattan	Comprehensive Engineering Chemistry	2nd Edition	S.K. Kataria & Sons Delhi, India,	2009
Shashi Chawala	Theory and Practicals of Engineering Chemistry	3rd Edition	Dhanpat Rai and Company, India	2012
B. Ramadevi and P. Aparna	Lab manual for Engineering chemistry	1st Edition	S Chand Publications, New Delhi	2022

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
S.S. Dara	A text book on experiments and calculation in Engineering Chemistry	1st Edition	S Chand Publications, New Delhi, India	2008
G H Jeffery, J Bassett, J Mendham, R C Denney	Inorganic quantitative analysis, Vogel	4th Edition	Bath Press, Avon, United Kingdom	1978

Program Outcomes (POs)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, and analyze complex engineering problems reaching substantiated conclusions with consideration for the holistic nature of the problem.

PO3. Design/development of solutions: Design creative solutions for complex engineering problems and design systems, components, or processes to meet identified needs — with consideration for public health and safety, and cultural, societal, and environmental factors. Sustainability is now intrinsic to design.

PO4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

PO5. Engineering Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling — recognising their limitations — to solve complex engineering problems. (Previously titled "Modern Tool Usage.")

PO6. The Engineer and the World: Analyse and evaluate societal and environmental aspects while solving complex engineering problems, considering their impact on sustainability with reference to economy, health, safety, legal frameworks, culture, and the environment.

PO7. Ethics: Apply ethical principles and commit to professional ethics, human values, diversity, and inclusion; and adhere to relevant national and international laws. (Diversity and inclusion are now explicit additions.)

PO8. Individual and Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse and multi-disciplinary teams.

PO9. Communication: Communicate effectively and inclusively within the engineering community and with society at large — comprehending and writing effective reports and design documentation, and making effective presentations — considering cultural, language, and learning differences.

PO10. Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects in multi-disciplinary environments.

PO11. Life-Long Learning: Recognise the need for, and have the preparation and ability for, independent and life-long learning, adaptability to new and emerging technologies, and critical thinking in the broadest context of technological change.

DEPARTMENT OF PERSONALITY DEVELOPMENT AND CAREER COUNSELLING							
Program: - Bachelor of Technology/Biosciences/Life Sciences/Geology/Microbiology							
Semester	I/II	***Course Title***		***Professional Communication***		***Code***	PDCC-A 101/201
Course Components		***Credits***		***Contact Hours***	***L***	***T***	***P***
Ability Enhancement Course		02			02	00	00
Examination Duration (Hrs)		***Theory***	***Practical***	***WEIGHTAGE: EVALUATION***	***CIE***	***MSE***	***ESE***
		03	00		25	25	50

Course Outcomes	
CO1	Understand grammar usage for accurate sentence construction to improve clarity in written and spoken English.
CO2	Apply presentation and interpersonal communication skills with appropriate non-verbal cues in different communication settings.
CO3	Analyse audience behaviour and non-verbal communication patterns for improving communication effectiveness.
CO4	Formulate corporate communication documents using standard professional formats with appropriate language and style.
CO5	Develop essential linguistic, interpersonal, and corporate communication skills necessary for academic excellence and professional growth.
Pre-requisite	Functional Grammar, Basic writing skills

Unit No.	***Content***	***Contact Hours***
Unit -1	**FUNCTIONAL GRAMMAR:** Sentence Correction based on Nouns, Pronoun, Adjective, Verb, Adverb, and Tenses. (using Language Lab)	8
Unit -2	**EFFECTIVE COMMUNICATION:** Principles, Barriers, Communication based on Formality, Media and Party, Non-verbal Communication Characteristics, Components: Paralanguage, Kinesics and Proxemics, Oral Presentations: Process, Components, Principles, Effective Skills, Methods of Speaking, Audience Analysis.	8
Unit -3	**CORPORATE COMMUNICATION:** Memo Writing, Notice and Email writing, Agenda and Minutes of the meeting, Précis Writing: Do's and Don'ts, Paragraph Writing –Descriptive, Imaginative, Analytical and Informative (150 words), Introduction to Writing using AI Tools: ChatGPT, Gemini, Meta, Perplexity, Quillbot, Claude.	14
	Total Hours	**30**

Textbooks:

Authors Name	Title	Edition	Publisher, Country	Year
Wren & Martin Revised by: Dr. N.D.V Prasad Rao	English Grammar and Composition	Regular	S. Chand, India	2026
Kumar S. and Lata P.	Communication Skills	3rd	Oxford University Press, India	2024

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
A.K.Jain	Professional Communication Skills	8e	S.Chand	2025
Raman M. and Sharma S.	Technical Communication	4th	Oxford University Press	2024
Sastra Deemed University	Effective Technical Communication	1st	Pearson	2024
Raymond Murphy	Essential English Grammar	2nd	Cambridge University Press	2024
Martin Hewins	Advance Grammar in use	Latest	Cambridge University Press	2025

Course Articulation Matrix

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	Understand grammar usage for accurate sentence construction to improve clarity in written and spoken English.	-	-	-	-	-	-			1	-	3
CO2	Apply presentation and interpersonal communication skills with appropriate non-verbal cues in different communication settings.							2	2	2		3
CO3	Analyse audience behaviour and non-verbal communication patterns for improving communication effectiveness.	-	-	-	-	-	-	1	2	3	-	3
CO4	Formulate corporate communication documents and business letters using standard professional formats with appropriate language and style.	-	-	-	-	-	-	1		3	-	3
CO5	Develop essential linguistic, interpersonal, and corporate communication skills necessary for academic excellence and professional growth.	-	-	-	-	-	-	1	3	3	-	3
		-	-	-	-	-	-	**1.25**	**2.3**	**2.4**	-	**3**

High correlation (3); Medium correlation (2); Low correlation (1); No correlation (-)

<table>
<tr><th colspan="8">Department of Mathematics</th></tr>
<tr><td colspan="8">Program: B.Tech. (All Branches Except Bio-Tech.)</td></tr>
<tr><td colspan="2">Semester</td><td>I</td><td colspan="2">Course Title</td><td colspan="2">Engineering Mathematics-I</td><td>Code</td><td>TMA 101</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="3">Discipline Specific Course (DSC)</td><td colspan="2">03</td><td>02</td><td>01</td><td>00</td></tr>
<tr><td colspan="3" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">Weightage Evaluation</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td>Pre-requisite</td><td colspan="8">Basic Knowledge of Mathematics</td></tr>
<tr><td colspan="9">Course Outcomes</td></tr>
<tr><td>CO1</td><td colspan="8">Analyze the concept of matrices and its application for finding the solution of system of linear equations.</td></tr>
<tr><td>CO2</td><td colspan="8">Implement the concepts of differential calculus in various disciplines of Engineering.</td></tr>
<tr><td>CO3</td><td colspan="8">Evaluate maxima / minima of function of several variables.</td></tr>
<tr><td>CO4</td><td colspan="8">Determine area and volume of different curves and shapes using multiple integrals.</td></tr>
<tr><td>CO5</td><td colspan="8">Explain vector calculus for different Engineering problems.</td></tr>
<tr><td>Unit No.</td><td colspan="7">Content</td><td>Contact Hours</td></tr>
<tr><td>Unit -1</td><td colspan="7">Matrices:
Linear dependency and independency of vectors, Inverse of a matrix, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian and orthogonal matrices, Rank of a matrix, Rank-Nullity theorem, System of linear equations, Characteristic equation, Cayley-Hamilton theorem, Eigenvalues and eigenvectors, Orthogonal transformation, Diagonalization of matrices.</td><td>11</td></tr>
<tr><td>Unit -2</td><td colspan="7">Calculus I:
Rolle’s Theorem, Mean value theorem and its applications, Extreme value of functions, Indeterminate forms and L'Hospital's rule, Linear approximation, Successive differentiation, Leibnitz’s theorem, Limits, Continuity and differentiability of function of two variables, Taylor’s and Maclaurin’s theorems with remainders.</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="7">Calculus-II:
Partial Differentiation, Total derivative, Homogeneous function, Euler’s theorem, Extrema (Maxima/ Minima) of functions of several variables and saddle points, Method of Lagrange’s multipliers, Introduction of Jacobian and its properties.</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="7">Calculus-III:
Evaluation of definite and improper integrals, Beta and Gamma functions with their properties, Double integrals (Cartesian coordinates), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: area and volume, Triple integrals (Cartesian), Simple applications involving cubes, sphere and rectangular parallelepipeds.</td><td>10</td></tr>
</table>

Unit -5	**Vector Calculus:** Introduction to vectors, Scalar line integrals, Vector line integrals, Gradient, Curl and Divergence, Scalar surface integrals, Vector surface integrals, Directional derivatives, Gradient, Tangent plane and normal line, Green, Gauss and Stokes theorems (without proof).	8
	Total Hours	45

Text Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
C. B. Gupta, S. R. Singh and Mukesh Kumar	Engineering Mathematics for Semesters I and II	1st	McGraw Hill Education	2015
N.P. Bali and Manish Goyal	A text book of Engineering Mathematics	9th	Laxmi Publications, Reprint, 2008	2016
Gorakh Prasad and Chandrika Prasad	Textbook of differential calculus	11th	Pothishala Pvt. Ltd, Allahabad	1968
R. K. Jain and S. R. K. Iyengar	Advanced Engineering Mathematics	5th	Narosa Publication	2019
Erwin Kreyszig	Advanced Engineering Mathematics	9th	Wiley Publications	2014
G. B. Thomas and R. L. Finney	Calculus and Analytic geometry	9th	Addison-Wesley Publishing Company	2010
B. V. Ramana	Higher Engineering Mathematics	6th	Tata McGraw Hill publications	2006

Reference Books:

Authors Name	**Title**	**Edition**	**Publisher, Country**	**Year**
B. S. Grewal	Higher Engineering Mathematics	44th	Khanna Publications, India	2022
Tom M. Apostol	Calculus-Volume 2	2nd	Wiley Publications	2022
Reena Garg	Advanced Engineering Mathematics	1st	Khanna Book Publishing Company 2021	2022
T. Veerarajan	Engineering Mathematics (for First Year)	5th	Tata McGraw-Hill, New Delhi	2008

<table>
<tr><th colspan="8">Department of Mathematics</th></tr>
<tr><td colspan="8">Program: B. Tech. (AI)</td></tr>
<tr><td>Semester</td><td>I</td><td colspan="2">Course Title</td><td colspan="2">Engineering Mathematics for Artificial Intelligence - I</td><td>Code</td><td>TMA 102</td></tr>
<tr><td colspan="2">Course Components</td><td colspan="2">Credits</td><td rowspan="2">Contact Hours</td><td>L</td><td>T</td><td>P</td></tr>
<tr><td colspan="2">Discipline Specific Course (DSC)</td><td colspan="2">03</td><td>02</td><td>01</td><td>00</td></tr>
<tr><td colspan="2" rowspan="2">Examination Duration (Hrs)</td><td>Theory</td><td>Practical</td><td rowspan="2">Weightage Evaluation</td><td>CWA</td><td>MSE</td><td>ESE</td></tr>
<tr><td>03</td><td>00</td><td>25</td><td>25</td><td>50</td></tr>
<tr><td>Pre-requisite</td><td colspan="7">Basic Knowledge of Mathematics</td></tr>
<tr><td colspan="8">Course Outcomes</td></tr>
<tr><td>CO1</td><td colspan="7">Analyze the concept of matrices and its application.</td></tr>
<tr><td>CO2</td><td colspan="7">Discriminate valid and invalid arguments using Mathematical logics.</td></tr>
<tr><td>CO3</td><td colspan="7">Implement the concepts of differential calculus in various problems related to AI.</td></tr>
<tr><td>CO4</td><td colspan="7">Evaluate maxima / minima of function of several variables.</td></tr>
<tr><td>CO5</td><td colspan="7">Determine area and volume of different curves and shapes using multiple integrals.</td></tr>
<tr><td>Unit No.</td><td colspan="6">Content</td><td>Contact Hours</td></tr>
<tr><td>Unit -1</td><td colspan="6">Matrices:
Scalars, Vectors, Matrices, Tensors: Notations and operations. Matrix multiplication and its role in neural networks. Linear dependency and independency of vectors, Inverse of a matrix, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian and orthogonal matrices, Characteristic equation, Cayley-Hamilton theorem, Eigenvalues and eigenvectors, Orthogonal transformation, Diagonalization of matrices, Single value decomposition (SVD) and its use in compression.</td><td>11</td></tr>
<tr><td>Unit -2</td><td colspan="6">Mathematical Reasoning:
Fundamentals of Logical reasoning in AI: Propositions, Truth tables, Logical connectives. Proof strategies and Inference: Inductive and deductive reasoning. Set theory and Symbolic abstraction: Sets, Subsets, Notation for tokens, Latent representations. Functions, Relations and Mappings: Functions as mappings in neural networks, Relations, equivalence and ordering in embedding spaces</td><td>8</td></tr>
<tr><td>Unit -3</td><td colspan="6">Calculus-I:
Limit and continuity, Derivatives and gradients in multiple dimensions, Partial derivatives and gradient vectors, Chain rule and backpropagation, Indeterminate forms and L'Hospital's rule, Linear approximation, Successive differentiation, Leibnitz’s theorem.</td><td>8</td></tr>
<tr><td>Unit -4</td><td colspan="6">Calculus-II:
Extreme value of functions, Saddle point, Jacobian, Gradient fields, Hessians, Application in Artificial Intelligence.</td><td>8</td></tr>
<tr><td>Unit -5</td><td colspan="6">Calculus III:
Evaluation of definite and improper integrals, Beta and Gamma functions with their properties, Double integrals (Cartesian coordinates), Change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: area and volume, Triple integrals (Cartesian), Simple applications involving cubes, sphere and rectangular parallelepipeds.</td><td>10</td></tr>
<tr><td></td><td colspan="6">Total Hours</td><td>45</td></tr>
</table>

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
N.P. Bali and Manish Goyal	A text book of Engineering Mathematics	9th	Laxmi Publications, Reprint, 2008	2016
Gorakh Prasad and Chandrika Prasad	Textbook of differential calculus	11th	Pothishala Pvt. Ltd, Allahabad	1968
R. K. Jain and S. R. K. Iyengar	Advanced Engineering Mathematics	5th	Narosa Publication	2019
Erwin Kreyszig	Advanced Engineering Mathematics	9th	Wiley Publications	2014
G. B. Thomas and R. L. Finney	Calculus and Analytic geometry	9th	Addison-Wesley Publishing Company	2010
B. V. Ramana	Higher Engineering Mathematics	6th	Tata McGraw Hill publications	2006
T. Veerarajan	Discrete Mathematics with Graph Theory and Combinatorics	1st	McGraw Hill Education	2017

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
B. S. Grewal	Higher Engineering Mathematics	44th	Khanna Publications, India	2022
Tom M. Apostol	Calculus-Volume 2	2nd	Wiley Publications	2022
Reena Garg	Advanced Engineering Mathematics	1st	Khanna Book Publishing Company 2021	2022
T. Veerarajan	Engineering Mathematics (for First Year)	5th	Tata McGraw-Hill, New Delhi	2008
Thomas Koshy	Discrete Mathematics with Applications	1st	Elsevier	2008

Department of Mathematics								
Program: B.Tech. (Biotechnology)								
Semester	One	**Course Title**		**Engineering Mathematics**			**Code**	TMA 103
Course Components		**Credits**		**Contact Hours**	**L**		**T**	**P**
Discipline Specific Course (DSC)		03			02		01	00
Examination Duration (Hrs)		**Theory**	**Practical**	**Weightage Evaluation**	**CWA**		**MSE**	**ESE**
		03	00		25		25	50
Pre-requisite	Basic Knowledge of Mathematics							
Course Outcomes								
CO1	Develop the concept of matrices for various Engineering problems.							
CO2	Evaluate maxima / minima of function of several variables.							
CO3	Implement the concepts of differential calculus in various problems.							
CO4	Demonstrate definite Integrals and its application in finding areas and volumes of different curves and shapes.							
CO5	Analyze the concept of sequence and series.							
Unit No.	**Content**							**Contact Hours**
Unit -1	**Matrices:** Introduction to matrices, Types of matrices, Algebra of matrices, Symmetric, Skew-symmetric and orthogonal matrices, Determinants, Inverse and rank of a matrix, Solution of System of linear equations by matrix method, Eigenvalues and eigenvectors, Cayley-Hamilton theorem.							11
Unit -2	**Calculus:** Rolle's theorem, Mean value theorem, Taylor and Maclaurin theorems with remainders, Indeterminate forms and L'Hospital's rule.							8
Unit -3	**Multivariate Calculus:** Limit, Continuity, Derivatives and partial derivatives, Gradient, Curl and divergence, Directional derivatives, Total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange's multipliers.							8
Unit -4	**Integral Calculus and its Applications:** Definite Integrals, Evaluation of definite and improper integrals, Introduction of Beta and Gamma functions and some elementary properties, Applications of definite integrals to evaluate surface areas and volume of revolutions.							10
Unit -5	**Sequences Series and Fourier series:** Introduction to sequence and series, Convergence of sequences and series, Tests for convergence, Power series, Taylor's series, Series for exponential, trigonometric and logarithmic functions, Fourier series for arbitrary interval, Fourier series for even and odd function, Half range sine and cosine series.							8
	Total Hours							45

Authors Name	Title	Edition	Publisher, Country	Year
C. B. Gupta, S. R. Singh and Mukesh Kumar	Engineering Mathematics for Semesters I and II	1st	McGraw Hill Education	2015
G.B. Thomas and R.L. Finney	Calculus and Analytic geometry	9th	Pearson	2002
Erwin Kreyszig	Advanced Engineering Mathematics	9th	John Wiley & Sons	2014
B.V. Ramana	Higher Engineering Mathematics	11th	Tata McGraw-Hill, New Delhi	2010
N.P. Bali and Manish Goyal	A textbook of Engineering Mathematics	9th	Laxmi Publications	2016

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
T. Veerarajan	Engineering Mathematics (for First Year)	5th	Tata McGraw-Hill, New Delhi, 2008	2008
Reena Garg and Chandrika Prasad	Advanced Engineering Mathematics	1st	Khanna Book Publishing Company	2022
D. Poole	Linear Algebra: A Modern Introduction	2nd	Brooks/Cole	2005
B. S. Grewal	Higher Engineering Mathematics	36th	Khanna Publications	2010

Department of Mathematics							
Program: B.Tech. (All Branches Except Bio Tech.)							
Semester	II	**Course Title**		**Engineering Mathematics -II**		**Code**	TMA 201
Course Components		**Credits**		**Contact Hours**	**L**	**T**	**P**
Discipline Specific Course (DSC)		03			02	01	00
Examination Duration (Hrs)		**Theory**	**Practical**	**Weightage Evaluation**	**CWA**	**MSE**	**ESE**
		03	00		25	25	50
Pre-requisite	Basic Knowledge of Mathematics						
Course Outcomes							
CO1	Classify ordinary differential equations to solve different Engineering problems.						
CO2	Implement the series solution for solving ordinary differential equations.						
CO3	Analyze the concept of limit of sequence and convergence of infinite series.						
CO4	Examine complex analytic functions and its applications.						
CO5	Evaluate integrals of complex variable functions having singularities in the given domain.						
Unit No.	**Content**						**Contact Hours**
Unit -1	**Ordinary differential equations:** Ordinary differential equation of first order (Exact, linear and Bernoulli's equations), Equations of first order but not of first degree: equations solvable for p, equations solvable for y and equations solvable for x, Clairaut's type, Linear differential equations of n^{th} order with constant coefficients, Complementary functions and particular integrals, Cauchy-Euler differential equation, Second order linear differential equations with variable coefficients, Method of variation of parameters and applications of ODE.						12
Unit -2	**Series solution and special function:** Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.						8
Unit -3	**Sequences and series:** Limits of sequence, Infinite series, Tests for convergence, Power series, Taylor and Maclaurin series, Convergence of Taylor series, p series test, Comparison test, Cauchy root test, Ratio test and Rabbe's test.						8
Unit -4	**Complex variable I:** Limit, Continuity and Differentiability of complex variable function, Analytic functions, Cauchy-Riemann equations, Harmonic functions, Finding harmonic conjugate, Elementary analytic functions (exponential, trigonometric, logarithmic) and their properties, Conformal mapping, Liner transformation, Mobius transformation and its properties.						8
Unit -5	**Complex variable II:** Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Taylor's series, Laurent's series, Zeros of analytic functions, Singularities, Residues, Cauchy-Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.						9
	Total Hours						45

Authors Name	Title	Edition	Publisher, Country	Year
Erwin Kreyszig	Advanced Engineering Mathematics	9th	Wiley India	2014
C. B. Gupta, S. R. Singh and Mukesh Kumar	Engineering Mathematics for Semesters I and II	1st	McGraw Hill Education	2015
C. B. Gupta, S. R. Singh and Mukesh Kumar	Engineering Mathematics for Semesters III and IV	1st	McGraw Hill Education	2016
B. S. Grewal	Higher Engineering Mathematics	44th	Khanna Publications	2022
S. L. Ross	Differential Equations, Ed.	3rd	Wiley India	1984
J. W. Brown and R. V. Churchill	Complex Variables and Applications, Ed.	7th	Mc-Graw Hill	2004

Reference Books:

Authors Name	Title	Edition	Publisher, Country	Year
Reena Garg	Advanced Engineering Mathematics	1st	Khanna Book Publishing Company	2022
Tom M. Apostol	'Calculus' Volume 2	2nd	Wiley Publications	2022
T. Veerarajan	Engineering Mathematics for first year	5th	Tata McGraw-Hill, New Delhi, 2008	2008
E. A. Coddington	An Introduction to Ordinary Differential Equations	1st	Prentice Hall India	1995
E. L. Ince	Ordinary Differential Equations	1st	Dover Publications	1958
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R. K. Jain and S. R. K. Iyengar	Advanced Engineering Mathematics	5th	Narosa Publication	2009

Department of Mathematics							
Program: B.Tech. (AI)							
Semester	II	**Course Title**		**Engineering Mathematics for Artificial Intelligence - II**		**Code**	TMA 203
Course Components		**Credits**		**Contact Hours**	**L**	**T**	**P**
Discipline Specific Course (DSC)		03			02	01	00
Examination Duration (Hrs)		**Theory**	**Practical**	**Weightage Evaluation**	**CWA**	**MSE**	**ESE**
		03	00		25	25	50
Pre-requisite	Basic Knowledge of Mathematics						

Course Outcomes		
CO1	Solve first order ordinary differential equations related to different Engineering problems.	
CO2	Implement the various methods for solving higher order ordinary differential equations.	
CO3	Analyze the first order partial differential equations and its applications	
CO4	Classify the second order partial differential equations	
CO5	Identify the significance of vector spaces.	
Unit No.	**Content**	**Contact Hours**
Unit -1	**Ordinary differential equations I:** Ordinary differential equation of first order: Exact, Equations reducible to exact equations, linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y and equations solvable for x, Clairaut's type.	8
Unit -2	**Ordinary differential equations II:** Linear differential equations of n^{th} order with constant coefficients, Cauchy-Euler differential equation, Second order linear differential equations with variable coefficients, Equation whose one solution of complementary function is known, Normal form, Solution of linear differential equations by changing the independent variables, Method of variation of parameters and applications of ODE in Artificial Intelligence.	10
Unit -3	**Partial Differential Equations I:** Introduction to PDE, Formation of PDE, solution first order PDE, Lagrange's, Charpit's, Monge's method, standard form of first order PDE.	8
Unit -4	**Partial Differential Equations II:** Solution of linear partial differential equations with constant coefficients of second order and their classifications: parabolic, Hyperbolic and elliptic, Method of separation of variables for solving partial differential equations	10
Unit -5	**Vector Space:** Vector space, basis Dimension, Subspace of vector space, Orthogonality, Projections, Linear transformation, rank and nullity theorem, Inverse of linear transformation, Inner product space, orthogonality, projection, Gram-Schmidt orthogonalization and QR decomposition.	9
	Total Hours	45

Text Books:

Authors Name	Title	Edition	Publisher, Country	Year
Erwin Kreyszig	Advanced Engineering Mathematics	9th	Wiley India	2014
B. S. Grewal	Higher Engineering Mathematics	44th	Khanna Publications	2022
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<table>
<tr><th colspan="8">Department of Environmental Science</th></tr>
<tr><td colspan="8">Program: B.Tech. (Common to all)</td></tr>
<tr><td>Semester</td><td colspan="2">First/ Second</td><td>Subject Title</td><td colspan="2">Environmental Science</td><td>Code</td><td>TEV 101 /TEV 201</td></tr>
<tr><td colspan="3">Course Components</td><td colspan="3">Credits</td><td colspan="2">Contact Hours</td></tr>
<tr><td colspan="3" rowspan="2">VAC/ MNG</td><td colspan="3" rowspan="2">02</td><td>L</td><td>T P</td></tr>
<tr><td>2</td><td>0 0</td></tr>
<tr><td rowspan="2">Examination Duration</td><td>Theory</td><td>Practical</td><td rowspan="2">Weightage Evaluation</td><td colspan="4" rowspan="2">Qualified / Non Qualified</td></tr>
<tr><td>03</td><td>00</td></tr>
<tr><td colspan="8">Course Objectives</td></tr>
<tr><td>CO1</td><td colspan="7">To create environmental awareness and knowledge</td></tr>
<tr><td>CO2</td><td colspan="7">To encourage participation in environmental conservation practices</td></tr>
<tr><td>CO3</td><td colspan="7">To develop critical thinking and apply those to the analysis of a problem or question related to the environment</td></tr>
<tr><td>CO4</td><td colspan="7">To evaluate impact of various human induced activities on the environment</td></tr>
<tr><td>CO5</td><td colspan="7">To design possible solutions to the real environmental problems.</td></tr>
<tr><td>CO6</td><td colspan="7">To create interest in research and innovation related with different aspects of environmental science.</td></tr>
<tr><td>Unit No.</td><td colspan="6">Contents</td><td>Hours</td></tr>
<tr><td>1.</td><td colspan="6">Environmental Science and Ecosystem
a. Definition of Environmental Science, Multidisciplinary nature, Objective, Scope and Importance.
b. Concept of an ecosystem, structure and function, energy flow, ecological succession, food chains, food webs, ecological pyramids.
c. Introduction, types, characteristic features, structure and function of the following ecosystem:
• Forest ecosystem
• Grassland ecosystem
• Desert ecosystem
• Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)</td><td></td></tr>
</table>

.	**Natural Resources and Biodiversity** **a**. Renewable and non- renewable resources. **b**. Natural resources and associated problems: • Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people. • **Water Resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems, water conservation, rainwater harvesting, watershed management. • **Mineral Resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies. • **Food Resources:** World food problems, Changes in landuse by agriculture and grazing, Effects of modern agriculture, Fertilizer/ pesticide problems, Water logging and salinity • **Energy Resources:** Increasing energy needs, Renewable/ non- renewable, Use of Alternate energy sources, urban problems related to energy, Case studies • **Land resources:** Land as a resource, land degradation, man-induced land-slides, soil erosion and desertification, wasteland reclamation **c**. Role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles. **d**. Definition of biodiversity, levels of biodiversity, value of biodiversity, threats to biodiversity (habitat loss, poaching of wildlife, man-wildlife conflicts). **e**. Biodiversity at global, national and local levels, India as a biodiversity nation, biogeographical classification of India, hotspots of biodiversity. **f**. Endangered and endemic species of India. **g**. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	
3.	**Environmental Pollution** Definition, causes, effects and control measures of Air Pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards. Solid waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, pollution case studies, pollution case studies.	
4.	**Important Environmental and Social Issues, Management and Legislation** **a.** Climate change, global warming, acid rain, Ozone layer depletion, nuclear accidents and holocaust, Case studies. **b.** Sustainable development, Resettlement and rehabilitation of people (its problems and concerns, case studies), Environmental ethics (issues and possible solutions), consumerism and waste products. **c.** Disaster management: floods, earthquake, cyclone and landslides. **d.** Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act. **e.** Issues involved in enforcement of environmental legislation, Public Awareness **f.** Population growth (variation among nation), Population explosion (family welfare programme), Environment and human health, human rights, value education, HIV/ AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, case studies.	

Text Books:

1. G. M. Wagh, Environmental Studies, Savera Publishing House, 2022.
2. Deswal, S. & Deswal A.: A Basic Course In Environmental Studies; Dhanpat Rai & Co., 2018

References:

1. Bharucha, Erach for University Grants Commission – Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education, University Grants Commission, New Delhi, 2004.
2. Kaushi, Anubha and Kaushik, C.P. – Perspectives in Environmental Studies, 2nd Edition, New Age International (P) Ltd, 2004.