Course Curriculum for
B.Tech.
In
Computer Science and Engineering
(Artificial Intelligence & Machine Learning)
Session 2022-23

Himachal Pradesh Technical University
Hamirpur, Distt. Hamirpur – 177001, Himachal Pradesh
(Established under Act No. 16 of 2010 of Himachal Pradesh Legislative Assembly)

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COMPUTER SCIENCE AND ENGINEERING (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

GENERAL COURSE STRUCTURE

&

CREDIT DISTRIBUTION

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GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits:

In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering must have around 165 credits, the total number of credits proposed for the four-year B. Tech/B.E. in Computer Science and Engineering in AI/ML is kept as 167.

C. Structure of UG Program in CSE (AI&ML):

The structure of UG program in CSE(Artificial Intelligence and Machine Learning)shall have essentially the following categories of courses with the breakup of credits as given:

S. No.	Category	Breakup of Credits
1.	Humanities & Social Science Courses	12
2.	Basic Science Courses	16
3.	Departmental Core Courses (Branch specific)	83
4.	Professional Elective Courses (Branch specific)	16
5.	Open Elective Courses (from Humanities, Technical Emerging or other Subjects)	06
6.	Project work, Seminar and Internship in Industry or elsewhere	34
7.	Non-Credit Mandatory Courses	Non-credit
	TOTAL	**167**

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D. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
HS	Humanities & Social Science Courses
AS	Applied Science Courses
CS	Computer Science Core Courses
PE	Professional Elective Courses
OE	Open Elective Courses
NC	Non-Credit Mandatory Courses*
EEEC	Employment, Entrepreneurship, Enhancement Courses Project/SummerInternship/Seminar)

- **Course level coding scheme:** Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix with the Course Code for identifying the level of the course. Digit at hundred's place signifies the year in which course is offered. e.g.

- **Category-wise Courses**

HUMANITIES & SOCIAL SCIENCES COURSES [HS]

(i) Number of Humanities & Social Science Courses: 6
(ii) Credits: 12

Sl. No	Course Code	Course Title	Hours per week			Total Credits	Semester
			Lecture	Tutorial	Practical		
1	HS-111L	Technical Communication Skills	2	0	2	3	
2	HS-113L	Humanities for Engineers	1	0	2	2	
3	HS-115L	Universal Human Values-II: Understanding Harmony And Ethical Human Conduct	2	1	0	3	
4	HS-117L	Design Thinking	0	0	2	01	
5	HS-411L	Computational Ecosystems for Entrepreneurship	3	0	0	03	
					Total Credits	12	

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APPLIED SCIENCE COURSES [AS]

(i) Number of Basic Sciences Courses: 06
(ii) Credits: 16

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	PHY-101L	Applied Physics	1	3	0	0	3
2	PHY-101P	Applied Physics Lab	1	0	0	2	1
3	CHM-101L	Applied Chemistry	2	3	0	0	3
4	CHM-101P	Applied Chemistry Lab	2	0	0	2	1
5	MA-101L	Applied Mathematics-I	1	3	1	0	4
6	MA-201L	Applied Mathematics-II	2	3	1	0	4
						Total Credits	16

COMPUTER SCIENCE CORE COURSES [CS]

(i) Number of Program Core Courses: 36
(ii) Credits: 83

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	CS-101L	Computer Programming and Problem Solving	1	3	0	0	3
2	CS-101P	Computer Programming Lab	1	0	0	2	1
3	CS-102L	Mathematical Concepts in AI	1	3	1	0	4
4	CS-201L	Object Oriented Programming	2	3	0	0	3
5	CS-201P	Object Oriented Programming Lab	2	0	0	2	1
6	CS-202L	Data Structures and Algorithms	2	3	0	0	3
7	CS-202P	Data Structures Lab	2	0	0	2	1
8	CS-203L	Discrete Mathematical Structures	2	3	1	0	4
9	CS-204L	Computer organization and Architecture	2	3	0	0	3
10	CS-301L	Operating System	3	3	0	0	3
11	CS-301P	Operating System Lab	3	0	0	2	1

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12	CS-305L	Software Engineering	3	3	0	0	3
13	CS-305P	Software Engineering Lab	3	0	0	2	1
14	CS-312L	Artificial Intelligence	3	3	1	0	4
15	CS-311L	Design And Analysis of Algorithms	3	3	0	0	3
16	CS-311P	Design And Analysis of Algorithms Lab	3	0	0	2	1
17	CS-313L	Introduction to Machine Learning	3	3	0	0	3
18	CS-313P	Machine Learning Lab	3	0	0	2	1
19	CS-411L	Theory of Computation	4	3	1	0	4
20	CS-404L	Computer Networks	4	3	3	0	3
21	CS-404P	Computer Networks Lab	4	0	0	2	1
22	CS-412L	Deep Learning	4	3	0	0	3
23	CS-412P	Deep Learning Lab	4	0	0	2	1
24	CS-403L	Database Management Systems	4	3	0	0	3
25	CS-403P	DBMS Lab	4	0	0	2	1
26	CS-511L	Data and Visual Analytics in AI	5	3	0	0	3
27	CS511P	Data and Visual Analytics in AI Lab	5	0	0	2	1
28	CS-512L	Natural Language Processing	5	3	0	0	3
29	CS-512P	Natural Language Processing Lab	5	3	0	0	1
30	CS-513L	Advanced Machine Learning	5	3	0	0	3
31	CS-513P	Advanced Machine Learning Lab	5	3	0	0	1
32	CS-515L	Compiler Design	5	3	0	0	3
33	CS-515P	Compiler Design Lab	5	0	0	2	1
34	CS-514L	Optimization Techniques in Machine Learning	5	3	1	0	4
35	CS-611L	Soft Computing	6	3	0	0	3
36	CS-611P	Soft Computing Lab	6	0	0	2	1
						Total	**83**

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PROFESSIONAL ELECTIVE COURSES [PE]

(i) Number of Professional Elective Courses: 04
(ii) Credits: 13

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	PE-***L	Professional Elective-I	6	3	0	2	4
2	PE-***L	Professional Elective-II	6	3	0	2	4
3	PE-***L	Professional Elective-III	7	3	0	2	4
4	PE-***L	Professional Elective-IV	7	3	0	2	4
						Total Credits	16

OPEN ELECTIVE COURSES [OE]

(i) Number of Open Elective Courses: 2
(ii) Credits: 6

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	OE-***L	Open Elective – I	3	3	0	0	3
2	OE-***L	Open Elective – II	6	3	0	0	3
						Total Credits	6

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

Sl. No	Course Code	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	EEEC-401,501	Minor Project	4,5	3	0	0	3+3
2	EEEC-801	Internship	7	-	-	-	15
3	EEEC-601,701	Capstone Project I & II	6,7,8	-	-	-	6+7
						Total Credits	34

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NON-CREDIT AUDIT COURSES [AU]

Note: These are mandatory non-credit courses.

S. No.	Course Code	Course Title	Semester	L	T	P	Credits
1	NC-411L	Environmental Science	4	3	0	0	0
2	NC-511L	Indian Constitution	5	3	0	0	0
Total Credits							**0**

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B.Tech Computer Science Engineering
AI/ML(2022 - 2023 Scheme)

SEMESTER-I

S. N.	SUBJECT CODE	SUBJECT TITLE	L	T	P	CR
1	PHY-101L	APPLIED PHYSICS	3	0	0	03
2	CS-101L	COMPUTER PROGRAMMING AND PROBLEM SOLVING	3	0	0	03
3	CS-102L	MATHEMATICAL CONCEPTS FOR AI	3	1	0	04
4	MA-101L	APPLIED MATHEMATICS-1	3	1	0	04
5	HS-113L	HUMANITIES FOR ENGINEERS	1	0	2	02
6	HS-111L	TECHNICAL COMMUNICATION SKILLS	2	0	2	03
7	CHM-101L	APPLIED CHEMISTRY	3	0	0	03
8	PHY-101P	APPLIED PHYSICS LAB	0	0	2	1
9	CS-101P	COMPUTER PROGRAMMING LAB	0	0	2	1
		TOTAL				24

SEMESTER-II

S. N.	SUBJECT CODE	SUBJECT TITLE	L	T	P	CR
1	MA-201L	APPLIED MATHEMATICS-II	3	1	0	04
2	CS-201L	OBJECT-ORIENTED PROGRAMMING	3	0	0	03
3	CS-202L	DATA STRUCTURES AND ALGORITHMS	3	0	0	03
4	CS-203L	DISCRETE MATHEMATICAL STRUCTURES	3	1	0	04
5	CS-204L	COMPUTER ORGANISATION AND ARCHITECTURE	3	0	0	03
6	HS-115L	UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY ETHICAL HUMAN CONDUCT	2	1	0	03
7	CS-201P	OBJECT ORIENTED PROGRAMMING LAB	0	0	2	01
8	CS-202P	DATA STRUCTURES AND ALGORITHMS LAB	0	0	2	01
9	HS-117L	DESIGN THINKING	0	0	2	01
10	CHM-101P	APPLIED CHEMISTRY LAB	0	0	2	01
		TOTAL				24

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SEMESTER-III

S. N.	SUBJECT CODE	SUBJECT TITLE	L	T	P	CR
1	CS-311L	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	03
2	CS-312L	ARTIFICIAL INTELLIGENCE	3	1	0	04
3	CS-305L	SOFTWARE ENGINEERING	3	0	0	03
4	CS-301L	OPERATING SYSTEM	3	0	0	03
5	CS-313L	INTRODUCTION TO MACHINE LEARNING	3	0	0	03
6	OE-***L	OPEN ELECTIVE-I	3	0	0	03
7	CS-311P	DESIGN AND ANALYSIS OF ALGORITHMS LAB	0	0	2	01
8	CS-305P	SOFTWARE ENGINEERING LAB	0	0	2	01
9	CS-301P	OPERATING SYSTEM LAB	0	0	2	01
10	CS-313P	MACHINE LEARNING LAB	0	0	2	01
		TOTAL				23

* To be chosen from open electives OE001 and OE002

SEMESTER-IV

S. N.	SUBJECT CODE	SUBJECT TITLE	L	T	P	CR
1	CS-411L	THEORY OF COMPUTATION	3	1	0	04
2	CS-403L	DATABASE MANAGEMENT SYSTEMS	3	0	0	03
3	CS-412L	DEEP LEARNING	3	0	0	03
4	CS-404L	COMPUTER NETWORKS	3	0	0	03
5	HS-411L	THEORY OF COMPUTATION ECOSYSTEMS	3	0	0	03
6	NC-411L	ENVIRONMENTAL SCIENCE	3	0	0	00
7	CS-403P	DBMS LAB	0	0	2	01
8	CS-412P	DEEP LEARNING LAB	0	0	2	01
9	CS-404P	COMPUTER NETWORKS LAB	0	0	2	01
10	EEEC-401	MINOR PROJECT-	3	0	0	03
		TOTAL				22

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SEMESTER-V

S. N.	COURSE NO.	TITLE	L	T	P	CR
1	CS-511L	DATA AND VISUAL ANALYTICS IN AI	3	0	0	03
2	CS-512L	NATURAL LANGUAGE PROCESSING	3	0	0	03
3	CS-513L	ADVANCED MACHINE LEARNING	3	0	0	03
4	CS-514L	OPTIMIZATION TECHNIQUES IN MACHINE LEARNING	3	1	0	04
5	CS-515L	COMPILER DESIGN	3	0	0	03
6	NC-511L	INDIAN CONSTITUTION	3	0	0	0
7	CS-515P	COMPILER DESIGN LAB	0	0	2	01
8	CS-513P	ADVANCED MACHINE LEARNING LAB	0	0	2	01
9	CS-512P	NATURAL LANGUAGE PROCESSING LAB	0	0	2	01
10	CS-511P	DATA AND VISUAL ANALYTICS IN AI LAB	0	0	2	01
11	EEEC-501	MINOR PROJECT	3	0	0	03
		TOTAL				23

SEMESTER-VI

S. N.	COURSE NO.	TITLE	L	T	P	CR
1	CS-611L	SOFT COMPUTING	3	0	0	03
2	PE-***L	PROFESSIONAL ELECTIVES-I	3	0	2	04
3	PE-***L	PROFESSIONAL ELECTIVE-II	3	0	2	04
4	OE-***L	OPEN ELECTIVE-II	3	0	0	03
5	CS-611P	SOFT COMPUTING LAB	0	0	2	01
6	EEEC-601	CAPSTONE PROJECT-I	-	-	-	06
		TOTAL				21

- To be chosen from open electives OE003 and OE004

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SEMESTER-VII

S. N.	COURSE NO.	TITLE	L	T	P	CR
1	PE-***L	PROFESSIONAL ELECTIVES-III	3	0	2	04
2	PE-***L	PROFESSIONAL ELECTIVES-IV	3	0	2	04
3	EEEC-701	CAPSTONE PROJECT-II	0	0	14	07
		TOTAL	5	0	8	15

SEMESTER-VIII

S. N.	COURSE NO.	TITLE	CODE	L	T	P	CR
1	EEEC-801	INDUSTRY/RESERCH LAB INTERNSHIP		-	-	-	15

Internship option	Alternate option
• Within India or Abroad (MITACS/DAAD/Any other aligned with GOI schemes) • To enhance hands-on skills (As per NEP-2020)	• Alternatively, Courses can also be offered from. • OpenElectives/Professional Electives • Two Course of 3 credits each and one Major project for 10 credits. Students may opt for a virtual internship along with courses.

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Open Electives (3 Credits)

S.No	Subject Code	Subject Title	Credits	L	T	P
1.	OE001	IOT	3	2	0	2
2.	OE002	Robotics	3	2	0	2
3.	OE003	Machine Learning with Python	3	2	0	2
4.	OE004	AI for Everyone	3	2	0	2

Professional Electives (4 Credits)

S.No	Subject Code	Subject Title	Credits
1	PE001	Statistical Thinking for Data Science	4
2	PE002	Machine Learning for Data Science	4
3	PE003	Data Visualization	4
4	PE004	Big Data Analytics	4
5	PE005	Solve Business Problems with AI	4
6	PE006	Pattern Recognition & Visual Recognition	4
7	PE007	Image and Video Processing	4
8	PE008	Deep Learning for Computer Vision	4
9	PE009	Autonomous Systems	4
10	PE010	Bioinformatics	4
11	PE011	Genome Sequencing	4
12	PE012	Algorithms for DNA Sequencing	4
13	PE013	Computational Neuroscience	4
14	PE014	AI in Gaming	4
15	PE015	AI in Healthcare	4
16	PE016	AI in Finance	4
17.	PE017	Predictive Analytics	4

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PHY-101L: APPLIED PHYSICS

Course Code	**PHY-101L**	**Credits-03**	**L-3, T-0, P-0**
Name of Course	**APPLIED PHYSICS**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: To introduce the students, basic physical laws of oscillations, acoustics of buildings, ultrasonics, electromagnetic waves, optics, quantum mechanics and demonstrate their technological applications. To explore the ideas for the measurement, principles, and their applications to investigate physical phenomena.

UNIT-I

Oscillations and Waves: Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; ***Acoustics***: Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; ***Ultrasonics***: Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.

UNIT-II

Electromagnetic Waves: Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.

UNIT-III

Optics: ***Interference***: Parallel and wedge-shape thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. ***Diffraction***: Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. ***Polarization***: Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows.

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UNIT-IV

Quantum Mechanics: Introduction to quantum physics, Black body radiation, Planck's law, Photoelectric effect, Compton effect, de-Broglie's hypothesis, Wave-particle duality, Davisson and Germer experiment, Heisenberg's Uncertainty principle, Schrodinger's wave equation, Particle in one dimensional box.

Course Learning Outcomes (CLOs):

On the completion of this course, the students will be able to:

- Understand the knowledge of fundamentals of oscillation and waves, electromagnetic waves, optics and quantum mechanics enable the students to apply to various systems as per their applications.
- help the students to prepare new objectives and materials for various engineering applications.
- help the students to be exposed to different physical phenomena.

Text Books:

1. R. N. Chaudhuri, Waves and Oscillations, New Age International-Publisher.
2. Ajay Ghatak, Optics, McGraw-Hill-Publisher.
3. B.K. Pandey, S. Chaturvedi, Engineering Physics, Cengage Learning-Publisher.
4. A. Beiser, Concept of Modern Physics, Tata McGraw Hill-Publisher
5. D.J. Griffiths, Introduction to Electrodynamics, Prentice Hall of India-Publisher

Reference Books:

1. M.R. Wehr, J.A. Richards, T.W. Adair, Physics of the Atom, Narosa Publishing House.
2. N.K. Verma, Physics for Engineers, Prentice Hall.
3. Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall.

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PHY-101P- APPLIED PHYSICS LAB

Course Code	PHY-101P	Credits – 01	L - 0, T - 0, P - 2
Name of Course	Applied Physics Lab		
Practical Internal Assessment	MM:30	Min. Marks :12	Total: 50 Marks
Practical External Assessment	MM:20	Min. Marks :8	

Laboratory Work:

1. Characteristics of P-N junction diode.
2. Characteristics of solar cell.
3. Characteristics of light emitting diode.
4. Hall co-efficient of a given Semiconductor.
5. Wavelength of He-Ne laser using transmission diffraction grating.
6. Wavelength of sodium light using spectrometer/diffraction grating.
7. Planck's constant using photocell/stopping potential
8. Study of B-H Curve
9. Ionization potential of Mercury.
10. Study of Malus' Law in polarization.

Note: *Students are required to perform at least Eight experiments. Other experiments may also be included at Institutional/Departmental level if equipment's are available.*

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CS-101L: COMPUTER PROGRAMMING AND PROBLEM SOLVING

Course Code	**CS-101L**	**Credits-03**	**L-3, T-0, P-0**
Name of Course	**Computer Programming and Problem solving**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

UNIT-I

Computers Fundamentals: Binary Number System, Computer memory, Computer Software.

Algorithms and Programming Languages: Algorithm, Flowcharts, Generation of Programming Languages.

UNIT-II

C Language: Structure of C Program, Life Cycle of Program from Source code to Executable, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types inC, variables, constants, input/output statements in C, operators, type conversion and type casting. Conditional branching statements, iterative statements, nested loops, break and continue statements.

Functions: Declaration, Definition, Call and return, Call by value, Call by reference, showcase stack usage with help of debugger, Scope of variables, Storage classes, Recursive functions, Recursion vs. Iteration.

UNIT-III

Arrays, Strings and Pointers: One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: traversal, insertion, deletion, merging and searching, Inter-function communication via arrays: passing a row, passing the entire array, matrices. Reading, writing and manipulating Strings, understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers.

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UNIT-IV

Structures and Union: Defining a Structure, declaring a structure variables, Accessing Structure Elements, and Union.

File Handling: Defining and Opening a File, closing a File, reading from a File, Writing intoa File.

Course Learning Outcomes (CLOs):

On completion of this course, the students will be able to:

1. Comprehend and analyze the concepts of number system, memory, compilation anddebugging of the programs in C language.
2. Understanding of the fundamental data types, operators and console I/O functions as anaspect of programs.
3. Design and create programs involving control flow statements, arrays, strings and implement the concept of dynamics of memory allocations.
4. Evaluate and analyze the programming concepts based on user define data types andfile handling using C language.

Text Books:

1. Brian W. Kernighan Dennis M. Ritchie, C Programming Language, 2nd ed, 2012.
2. Balagurusamy G., Programming in ANSI C, 8th ed., 2019

Reference Books:

1. Kanetkar Y., Let Us C, 16th ed.,2017

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CS-101P: COMPUTER PROGRAMMING LAB

Course Code	**CS-101P**	**Credits – 01**	**L - 0, T - 0, P - 2**
Name of Course	**Computer Programming Lab**		
Practical Internal Assessment	**MM:30**	**Min. Marks :12**	**Total: 50 Marks**
Practical External Assessment	**MM:20**	**Min. Marks :8**	

Course Objectives: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

Laboratory/ Practical's:
To implement Programs for various kinds of programming constructs in C Language.

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CS-102L: MATHEMATICAL CONCEPTS FOR AI

Course Code	CS-102L	Credits-04	L-3, T-1, P-0
Name of Course	Mathematical Concepts for AI		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: This course should help the students understand the basic mathematical background of AI. Also, thestudents should be able to apply statistics and probability to analyse various datasets.

UNIT-I

Equations, Functions and Graphs: Introduction to linear equations, Intercepts and slopes, System of equations, Exponentials, radicals and logarithms, Polynomials, Polynomial operations, Factorizations, Introduction to quadratic equations, Functions

Derivatives and Optimizations: Rate of change, Introduction to limits, Continuity, finding limits, Differentiability, Derivative rules and operations, using derivatives to analyse functions, Second order derivatives, Optimization functions, Multivariate differentiation

UNIT-II

Vectors and Matrices: Introduction to vectors, Vector addition, vector multiplication, Introduction to matrices, matric multiplication, properties of matrices, types of matrices, Matrix division, solving system of equations with matrices, Matrix transformations, Eigen values and eigen vectors, rank of matrix

UNIT-III

Probability: Basic rules and axioms events, sample space, dependent and independent events, conditional probability, Random variables- continuous and discrete, expectation, variance, distributions- joint and conditional, Bayes' Theorem, Popular distributions- binomial, Bernoulli, poisson, exponential, Gaussian

UNIT-IV

Statistics: Fundamentals of Data: Collection, Summarization, and Visualization; Sampling and Sampling Distributions, Central Limit Theorem; Methods of Estimation, Unbiased

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estimators; Confidence Interval Estimation: Z-interval, t-interval; Hypothesis Testing, Types of Errors, Rejection Region Approach and p-value Approach.

Text Books/Suggested References:

1. Mathematics for Machine Learning, Marc Peter Deisenroth, A. Aldo Faisal, Cheng SoonOng, Cambridge University Press., 2020
2. Advanced Engineering Mathematics, Reena Garg, Khanna Book Publishing Co., Delhi.
3. Machine Learning, Rajiv Chopra, Khanna Book Publishing Co., Delhi.
4. Introduction to Applied Linear Algebra: Vectors, Matrices, and Least Squares, StephenBoyd, Lieven Vandenberghe, Cambridge University Press., 2018
5. Probability and statistics for Engineers and Scientists, Walpole, Myers, Myers and Ye,Pearson Education, 2012
6. Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill, 1995
7. https://www.udemy.com/course/mathematical-foundation-for-machine-learning-and-ai/

Course outcomes: After completion of course, students would be able to:

1. To understand the mathematical background of AI.
2. Use statistical methods to analyze and collect data.
3. Use probability and statistics to analyze data.
4. Use and apply hypothesis testing on different datasets.

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MA-101L: APPLIED MATHEMATICS-I

Course Code	MA-101L	Credits-04	L-3, T-1, P-0
Name of Course	APPLIED MATHEMATICS-I		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: To provide students with skills and knowledge in sequence and series, advanced calculus and calculus of several variables which would enable them to devise solutions for given situations they may encounter in their engineering profession.

UNIT-I

Sequences and Series: Introduction to sequences and Infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence and conditional convergence.

Series Expansions: Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.

UNIT-II

Calculus: Mean value theorem, Rolle's theorem, Lagrange's Cauchy mean value theorem, Application of definite integral to evaluate areas of bounded region, Arc length of a plane curve, volume of solids, surface areas of a solid revolution (Cartesian coordinates), Improper integrals.

UNIT-III

Partial Differentiation and applications: Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives, Lagrange's method of multipliers.

UNIT-IV

Multiple Integrals and applications: Double integral (Cartesian), Change of order of integration in double integral, Polar coordinates, graphing of polar curves, Change of variables (Cartesian to polar), Applications of double integrals to areas and volumes, evaluation of triple integral (Cartesian).

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Course Learning Outcomes (CLOs):

Upon completion of this course, the students will be able to

1. Examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima in some engineering problems.
2. Evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
3. Determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
4. Evaluate surface areas and volumes of revolution in some engineering problems.

Textbooks:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2. Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.
3. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics (2003), 2nd ed.

Reference Books:

1. Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
2. Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons (2011) 9th Edition.

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HS-113L: HUMANITIES FOR ENGINEERS

Course Code	**HS-113L**	**Credits-02**	**L-1, T-0, P-2**
Name of Course	**HUMANITIES FOR ENGINEERS**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: The objective of this course is to introduce values and ethical principles, that will serve as a guide to behavior on a personal level and in professional life. The course is designed to help the students to theorize about how leaders and managers should behave to motivate and manage employees; to help conceptualize conflict management strategies that managers can use to resolve organizational conflict effectively. It also provides background of demand and elasticity of demand to help in devising pricing strategy; to make strategic decisions using game theory and to apply techniques of project evaluation.

Unit 1: Human Values and Ethics Values: Introduction to Values, Allport-Vernon-Lindzey Study of Values, Rokeach Value Survey, Instrumental and Terminal Values. Moral and Ethical Values: Types of Morality, Kant's Principles of Morality, Factors for taking ethical decisions, Kohlberg's Theory of Moral Development Professional Ethics: Profession: Attributes and Ethos, Whistle-blowing.

Unit 2: Organizational Behavior: Introduction to the Field of Organizational Behaviour: Individual Behaviour, Personality, and Values, Perceiving Ourselves and Others in Organizations, Workplace Emotions, Attitudes, and Stress, Foundations of Employee Motivation and Leadership, Performance Appraisal, Conflict and Negotiation in the Workplace.

Unit 3: Economics Demand, Supply & Elasticity – Introduction to Economics, Demand & its Determinants, Elasticity and its types Production & Cost Analysis – Short run & Long Run Production Functions, Short run & Long run cost functions, Economies & Diseconomies of Scale Competitive Analysis & Profit Maximization – Perfect competition, Monopoly, Monopolistic & Oligopoly Markets Strategy & Game Theory – Pure Strategy & Mixed Strategy Games, Dominance, Nash Equilibrium, & Prisoner's Dilemma Capital Budgeting – Capital Projects, Net Present Value (NPV) & IRR techniques.

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Practical:

1. Practical application of these concepts by means of Discussions, Role-plays and Presentations,
2. Analysis of Case Studies on ethics in business and whistle-blowing, leadership, managerial decision-making.
3. Survey Analysis
4. Capital Budgeting assignment

Course Learning Outcomes (CLOs) : The student after completing the course will be able to:

1. Comprehend ethical principles and values and apply them as a guide to behavior in personal and professional life.
2. Apply tools and techniques to manage and motivate employees.
3. Analyse and apply conflict management strategies that managers can use to resolve organizational conflict effectively.
4. Devise pricing strategy for decision-making.
5. Apply techniques for project evaluation.

Text Books:

1. N. Tripathi, Human Values, New Age International (P) Ltd. (2009).
2. Robbins, S. P/ Judge, T. A/ Sanghi, S Organizational Behavior Pearson, New Delhi, (2009).
3. Petersen, H.C., Lewis, W.C. and Jain, S.K., Managerial Economics, Pearson (2006).

Reference Books:

1. McKenna E. F. Business psychology and organisational behaviour. Psychology Press, New York (2006).
2. Furnham A. The Psychology of Behaviour at Work: The Individual in the organization. Psychology Press, UK (2003).
3. Salvatore, D and Srivastava, R., Managerial Economics, Oxford University Press (2010).
4. Pindyck, R and Rubinfiled, D., Microeconomics, Pearson (2017

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HS-111L: TECHNICAL COMMUNICATION SKILLS

Course Code	HS-111L	Credits-03	L-2, T-0, P-2
Name of Course	TECHNICAL COMMUNICATION SKILLS		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Objective: The primary objective is to develop in the under-graduate students of engineering a level of competence in English required for independent and effective communication for academic and social needs.

UNIT-I

Communication Fundamentals: Analysing Communication; Technical Communication: Objectives and Definitions; Information and Communication Technology (ICT) in Organizations; Levels of Communication, Barriers to Communication, Communication in Professional Context, and Importance of Effective Communication.

UNIT-II

Listening Skills: Kinds of Listening, Hearing and Listening, Barriers in Listening, Enhancing Listening Skills.

Speaking Skills: Art of Speaking, Stages of Speaking, Speech Style and Techniques, Types-Extempore, impromptu, debate.

Reading Skills: Introduction of different kinds of reading materials: technical & non-technical; Reading Comprehension: Effective Reading Skills, Reading Strategies, Textual Reading of Essays—(i) CEM Joad's "A Dialogue on Civilization"; (ii) A G Gardiner's "On Saying Please".

Writing Skills: Effective writing practice; brevity & clarity in writing – Cohesion & coherence in writing; Report Writing, Proposals, Writing Minutes, Professional Correspondences-Letter Writing, Job Application Letter, Résumé and CV.

UNIT-III

Speech Mechanism: Focus on organs of Speech, Sound and Speech, Vowels and Consonants, Diphthongs, Speech Process

Phonetics; Phonology, Phonemes, Stress, Rhythm, Intonation, Morphemes, Register, Style, Cluster, Variety in English; Places and Manners of Articulations.

Developing Speaking Skills: Instructions, Face to Face Communication, Meetings, Public Speaking, Group Discussion, Team Talk, Presentations, Seminars, Conferences, Interviews Techniques, and Mock Interviews, Conversation Practice Based on Audio and Visual Aids,

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Dialogues Delivery, Speech and Debate, Speaking on a given topic, Extempore, Words Exercise and Words Games to enhance Self-Expression, Pronunciation Practices.

Verbal Ability: Verbal Ability focalizes on three levels of Language Viz. World Level, Sentence Level and Paragraph Level.

Non Violent Communication (NVC): Nonviolent Communication (NVC) is an approach to communication based on principles of nonviolence. Nonviolent Communication was developed by clinical psychologist Marshall Rosenberg beginning in the 1960s and 1970s, his book *Nonviolent Communication: A Language of Life* is an authoritative text. The objective is interpersonal harmony and obtaining knowledge for future cooperation. The concepts include rejection of coercive forms of discourse, gathering facts through observing without evaluating, genuinely and concretely expressing feelings and needs, and formulating effective and empathetic requests. Nonviolent communication is used both as a clinical psychotherapy modality and as a self-help technique, particularly to seek harmony in relationships and at workplaces. Nonviolent communication holds that most conflicts between individuals or groups arise from miscommunication about their human needs, due to coercive or manipulative language that aims to induce fear, guilt, shame, etc. These "violent" modes of communication, when used during a conflict, divert the attention of the participants away from clarifying their needs, their feelings, their perceptions, and their requests, thus perpetuating the conflict.

Components: There are four components to practice nonviolent communication: Observation, Feelings, Needs and Requests.

Modes: There are three primary modes of application of NVC: Self Empathy, Receiving Empathically and Expressing Honestly.

UNIT-IV

Remedial Grammar: Parts of Speech, Determiners, Modals, Tenses-Verb Agreement, Active and Passive Voice, Direct and Indirect Speech, Transformation of Sentences, Sentence Structure, Finding Common Errors.

Vocabulary Building: Synonyms, Antonyms, One Word Substitutions, Word Formations, Idioms and Phrases, Homophones, Prefix, Suffix and Vocabulary Usage, Spelling.

Text Books:

1. Bansal, R. K. and J B Harrison. *Spoken English: A Manual of Speech and Phonetics*. Orient BlackSwan, 2013.
2. Green, David. *Contemporary English Grammar Structures and Composition*. Macmillan Publishers India Limited, 2013.
3. Sharma, Sangeeta and Binod Mishra. *Communication Skills for Engineers and Scientists*. Prentice-Hall of India Pvt.Ltd, 2009, Sixth Reprint 2015
4. Kumar, Sanjay & Pushp Lata. *Communication Skills*. New Delhi: OUP, 2016.

Additional Books:

1. Allen, W.S. *Living English Speech*. Orient Longman, 1984.
2. Wallace, H.R. and Masters, L.A. *Personality Development for Work*. South-Western Educational Publication, 1996.
3. Carnegie, D. and Napoleon Hill. *Public Speaking & Pleasing Personality*. BN Publishing, 2006.
4. *Balasubramanian, T. A Textbook of English Phonetics for Indian Students*. MacMillan, 2000.
5. Mohan, Krishna and Meera Banerji. *Developing Communication Skills*. MacMillan, 2013.

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CHM-101L: APPLIED CHEMISTRY

Course Code	CHM-101L	Credits-03	L-3, T-0, P-0
Name of Course	APPLIED CHEMISTRY		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials and analytical techniques.

UNIT-I

Electrochemistry: Specific, equivalent and molar conductivity of electrolytic solutions, migration of ions, transference number and its determination by Hittorf's method, conductometric titrations, types of electrodes, concentration cells, liquid junction potential. **Fuels:** Classification of fuels, calorific value, cetane and octane number, fuel quality, comparison of solid liquid and gaseous fuels, properties of fuel, alternative fuels: biofuels, power alcohol, synthetic petrol.

UNIT-II

Water Treatment and Environment: Hardness and alkalinity of water, units and determination, external and internal methods of softening of water, domestic water treatment, Waste water and its treatment, BOD and COD, Greenhouse effect and global warming, Carbon credit.

UNIT-III – Engineering Materials

Nano Materials: Introduction, Preparation, Properties of nanomaterials, Graphene, Graphite, Fullerenes, Carbonnano-tubes, nano-wires, nano-cones, Application of nano-materials, **Polymers:** Introduction to polymers, types of polymerization, molecular weight determination, tacticity of polymers, catalysis in polymerization, conducting, biodegradable and inorganic polymers.

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UNIT-IV- Spectroscopy Techniques:

Introduction to spectroscopy, atomic and molecular spectroscopy, Beer-Lambert`s Law, UV-Visible, IR and NMR spectroscopic techniques - Principle, instrumentation and applications.

Course Learning Outcomes (CLOs):

The students will be able to reflect on:

1. Concepts of electrodes in electrochemical cells, migration of ions, liquid junction potential and conductometric titrations.
2. Atomic and molecular spectroscopy fundamentals- Beer`s law and its application, Basic principle, instrumentation and application of UV-Vis, IR and NMR technique.
3. Water treatment methods specifically in domestic and industrial application and environment
4. Laboratory techniques like pH metry, potentiometry, colourimetry, conductometry andvolumetry.

Text Books:

1. Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012) 1st ed.
2. Puri, B.R., Sharma, L.R., and Pathania, M.S. Principles of Physical Chemistry, VishalPublishing Co. (2008).
3. Aggarwal, S. Engineering Chemistry: Fundamentals and Applications, Cambridge University Press (2015).

Reference Books:

1. Brown, H., Chemistry for Engineering Students, Thompson, 1st ed
2. Sivasankar, B., Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd, New Delhi(2008).
3. Shulz, M.J. Engineering Chemistry, Cengage Learnings (2007) 1st ed.

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MA-201L: APPLIED MATHEMATICS-II

Course Code	MA-201L	Credits-04	L-3, T-1, P-0
Name of Course	APPLIED MATHEMATICS-II		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

UNIT-I

Linear Algebra: Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigenvalues, Eigenvectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

UNIT-II

Ordinary Differential Equations: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

UNIT-III

Laplace Transform: Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

UNIT-IV

Fourier Series: Introduction, Fourier series on arbitrary intervals, Half range expansions, Complex Fourier series, Harmonic analysis.

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Course learning outcome (CLO) :

Upon completion of this course, the students will be able to:

1. Solve the differential equations of first and second order and basic application problems described by these equations.
2. Find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. Solve systems of linear equations by using elementary row operations.
4. Identify the vector spaces/subspaces and to compute their bases / orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the Eigen values and Eigen vectors.

Textbooks:

1. Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).
2. Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).
3. Seymour Lipschutz, Marc Lipson, Schaum's Outline of Linear Algebra, 3rd ed.

Reference Books:

1. Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8th ed.
2. Jain, R.K. and Iyenger, S.R.K., Advanced Engineering Mathematics, Narosa Publishing House (2011), 11th ed.

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CS-201L: OBJECT ORIENTED PROGRAMMING

Course Code	CS-201L	Credits-03	L-3, T-0, P-0
Name of Course	Object Oriented Programming		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: To become familiar with object-oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

UNIT-I

Objects and Classes: Structure in C and C++, Class specification, Objects, Data hiding, Encapsulation and abstraction, namespaces, Array of objects, Passing objects as arguments, Returning object from a function, inline functions, Static data member and member function, 'const' member function.

Constructor and Destructor: Constructors, Parameterized Constructors, Constructor Overloading, Constructors in array of objects, Constructors with default arguments, Dynamic Initialization, Pointer to objects, this pointer, Dynamic memory allocation, Array of pointer toobjects, Copy Constructor, Static objects, Friend function, and Friend classes.

UNIT-II

Operator Overloading and Type Conversion: Syntax of operator overloading, Overloading Unary operator and Binary operator, Overloading arithmetic operator, relational operator, Overloading Unary operator and Binary operator using friend function, Data conversion, Overloading some special operators like (), [].

Inheritance: Derived Class declaration, Public, Private and Protected Inheritance, friend function and Inheritance, Overriding member function, Forms of inheritance, virtual base class, Abstract class, Constructor and Inheritance, Destructor and Inheritance, Advantage and disadvantage of Inheritance.

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UNIT-III

Polymorphism: Classification of Polymorphism, Compile time and Run time Polymorphism,Pointers to derived class object, Virtual functions, Pure virtual functions.

Templates: Need of template, Function templates, Function template with non-type parameter, Overloading function templates, Class templates, Class template with non-type parameter.

Standard Template Library: Fundamental idea about string, iterators, hashes and other types, The String and Vector classes vs. C-style pointers.

UNIT-IV

File handling: Formatted I/O, Hierarchy of file stream classes, Opening and closing a file, Working with multiple files, file modes, file pointers, Text vs. Binary Files.

Exception Handling: Exception handling mechanism, Multiple Catch Blocks, Catch All exceptions, Throw an exception, Exception Specification.

Course Learning Outcomes:

On completion of this course, the students will be able to:

1. Understand the basic concept of Classes, objects and Object Orientation, with basiclayout of an object-oriented program.
2. Comprehend the concept of constructors and destructors.
3. Demonstrate the prime concepts viz. overloading, polymorphism, abstraction and Inheritance of an object-oriented paradigm.
4. Grasp the File handling concepts and be able to use files.
5. Use template and Exception handling in an object-oriented programming.

Text Books:

1. Schildt H., C++: The Complete Reference, Tata McGraw Hill (2003) 4th ed.
2. Lippman B. S., Lajoie J., and Moo E. B., C++ Primer, Addison-Wesley Professional(2013) 5th ed.

Reference books:

1. Lafore R., Object-Oriented Programming in C++, Pearson Education (2002) 4th ed.
2. E Balagurusamy, Object Oriented Programming with C++ (2017) 7th ed.
3. Stroustrup B., The C++ programming language, Pearson Education India (2013) 4th ed.

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CS-201P: OBJECT ORIENTED PROGRAMMING LAB

Course Code	CS-201P	Credits – 01	L - 0, T - 0, P - 2
Name of Course	Object Oriented Programming Lab		
Practical Internal Assessment	MM:30	Min. Marks :12	Total: 50 Marks
Practical External Assessment	MM:20	Min. Marks :8	

Course Objectives: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

Laboratory/ Practical's:
To implement Programs for various kinds of programming constructs in C++ Language.

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CS-202L: DATA STRUCTURES AND ALGORITHMS

Course Code	**CS-202L**	**Credits-03**	**L-3, T-0, P-0**
Name of Course	**DATA STRUCTURES AND ALGORITHMS**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: To become familiar with different types of data structures and their applications.

UNIT-I

Analyzing algorithms: Importance of efficient algorithms, Order arithmetic, time and space complexity.

Linear Data Structures: Arrays, Records, Strings and string processing, References and aliasing, Linked lists (Singly, Doubly, Circular), Strategies for choosing the appropriate data structure, Abstract data types, their implementation and applications: Stacks (using Arrays and Linked-list), Queues (using Arrays and Linked-list), Hash tables, including strategies for avoiding and resolving collisions, Dictionaries, Sets, Maps.

UNIT-II

Searching and Sorting: Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Merge Sort, Counting Sort, Radix Sort. Introduction to internal, external, and distribution sorting techniques.

UNIT-III

Trees and their applications: Binary search trees, AVL Tree, Splay Tree, Red-Black Tree, B Tree and B+ Tree, Common operations on these trees such as select min, select max, insert, delete, traversals, iterate over tree. Heaps, Heap Sort Priority Queue, Fibonacci heaps and Binomial Heaps.

UNIT-IV

Graphs and their applications: Graphs and graph algorithms, Representations of graphs, Depth- and breadth-first traversals, Shortest-path algorithms (Dijkstra and Floyd), Data Structures for Disjoint Sets, Minimum spanning tree (Prim and Kruskal).

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Problem Classes: Introduction to P, NP, NP- Hard and NP-complete.

Course Learning Outcomes (CLOs) / Course Objectives (COs):

On completion of this course, the students will be able to

1. Implement basic data structures in solving fundamental problems.
2. Implement various searching and sorting techniques.
3. Implement tree and graph data structures along with their related operations.
4. Evaluate and apply appropriate data structure(s) for real-world problems.

Text Books:

1. Cormen H. T., Leiserson E. C., Rivest L. R., and Stein C., Introduction to Algorithms,MIT Press (2009) 3rd ed.
2. Sahni S., Data Structures, Algorithms and Applications in C++, Universities Press(2005) 2nd ed.

Reference Books:

1. Karumanchi N., Data Structures and Algorithms Made Easy, Career Monk Publications(2017) 5th ed.

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CS-202P: DATA STRUCTURES AND ALGORITHMS LAB

Course Code	**CS-202P**	**Credits – 01**	**L - 0, T - 0, P - 2**
Name of Course	**Data Structures and Algorithms Lab**		
Practical Internal Assessment	**MM:30**	**Min. Marks :12**	**Total: 50 Marks**
Practical External Assessment	**MM:20**	**Min. Marks :8**	

Course Objectives: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

Laboratory work:
Implementation of Arrays, Recursion, Stacks, Queues, Lists, Binary trees, AVL trees, Splay trees, Sorting techniques, Searching techniques.

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CS-203L: DISCRETE MATHEMATICAL STRUCTURES

Course Code	**CS-203L**	**Credits-04**	**L-3, T-1, P-0**
Name of Course	**DISCRETE MATHEMATICAL STRUCTURES**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: Detailed study of various discrete and algebraic structures, basic logic, basics of counting and proof techniques.

UNIT-I

Basic Logic: Propositional logic, Logical connectives, Truth tables, Normal forms (conjunctive and disjunctive), Validity of well-formed formula, Propositional inference rules (concepts of modus ponens and modus tollens), Predicate logic, Universal and existential quantification.

Sets, Relations, and Functions: Sets: Operations on set, Inclusion-exclusion principle, Representation of Discrete Structures, Fuzzy set, Multi-set, bijective function, Inverse and Composition of functions, Floor and Ceiling functions, Growth of functions: Big-O notation, Big-Omega and Big-Theta Notations, Determining complexity of a program, Hashing functions, Recursive function, Functions applications.

UNIT-II

Relations: Reflexivity, symmetry, transitivity, Equivalence and partial-ordered relations, Asymmetric, Irreflexive relation, Inverse and complementary relations, Partition and Covering of a set, N-ary relations and database, Representation relation using matrices and digraph, Closure of relations, Warshall's algorithm, Lexicographic ordering, Hasse diagram, Lattices, Boolean algebra, Application of transitive closure in medicine and engineering. Application: Embedding a partial order.

UNIT-III

Graphs Theory: Representation, Type of Graphs, Paths and Circuits: Euler Graphs, Hamiltonian Paths & Circuits; Cut-sets, Connectivity and Separability, Planar Graphs,

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Isomorphism, Graph Coloring, Covering and Partitioning, Max flow: Ford-Fulkerson algorithm, Application of Graph theory in real-life applications.

Algebraic Structures: Group, Semi group, Monoids, Homomorphism, Congruencies, Ring, Field, Homomorphism, Congruencies, Applications of algebra to control structure of a program, the application of Residue Arithmetic to Computers.

UNIT-IV

Proof Techniques and counting: Notions of implication, equivalence, converse, inverse, contra positive, negation, and contradiction, The structure of mathematical proofs, Direct proofs, Disproving by counter example, Proof by contradiction, Induction over natural numbers, Structural induction, Weak and strong induction, The pigeonhole principle, Solving homogenous and heterogeneous recurrence relations.

Course learning outcome (CLO) / Course Objectives (COs):

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

1. Perform operations on various discrete structures such as set, function and relation.
2. Apply basic concepts of asymptotic notation in analysis of algorithm.
3. Illustrate the basic properties and algorithms of graphs and apply them in modeling andsolving real-world problems.
4. Comprehend formal logical arguments and translate statements from a natural languageinto its symbolic structures in logic.
5. Identify and prove various properties of rings, fields and group.

Text Books:

1. Rosen H. K., Discrete Mathematics and its Applications, McGraw Hill (2011) 7th ed.
2. Tremblay P. J. and Manohar, R., Discrete Mathematical Structures with Applications toComputer Science, Tata McGraw Hill (2008).

Reference Books:

1. Gallian A. J., Contemporary Abstract Algebra, Cengage Learning (2017) 9th ed.
2. Lipschutz S., Lipson M., Discrete Mathematics, McGraw-Hill (2007) 3rd ed

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CS-204L: COMPUTER ORGANISATION AND ARCHITECTURE

Course Code	**CS-204L**	**Credits-03**	**L-3, T-0, P-0**
Name of Course	**COMPUTER ORGANISATION AND ARCHITECTURE**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Course Objectives: Focus is on the architecture and organization of the basic computer modules viz. controls unit, central processing unit, input-output organization and memory unit.

UNIT-I

Basics of Computer Architecture: Number System and code conversion, Logic gates, Flip flops, Registers, Counters, Multiplexer, De-multiplexer, Decoder, Encoder etc.

Register Transfer and Micro operations: Register transfer Language, Register transfer, Bus & memory transfer, Arithmetic micro operations, Logic micro operations, Shift micro operations, Design of ALU.

UNIT-II

Basic Computer Organization: Instruction codes, Computer instructions, Timing &control, Instruction Cycles, Memory, register, and input-output reference instructions, Interrupts,Complete computer description & design of basic computer.

Central Processing Unit: General register organization, Stack organization, Instruction format, Addressing modes, Data transfer & manipulation, Program control, RISC, CISC. Pipelining and hazards.

UNIT-III

Computer Arithmetic: Addition &Subtraction, Multiplication Algorithms, Division algorithms.

Memory Unit: Memory hierarchy, Processor vs. memory speed, High-speed memories, Main Memory, Cache memory and mapping schemes, Associative memory, Interleaving, Virtual memory, Memory management techniques.

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UNIT-IV

Multiprocessors: Characteristics of multiprocessors, Interconnection structures, Inter-processor arbitration, Inter-processor communication & synchronization. Peripheral devices, I/O interface Data transfer schemes, Program control, Synchronous and asynchronous data transfer, Interrupt, DMA transfer, I/O processor.

Course Learning Outcomes (CLOs) / Course Objectives (COs):

On completion of this course, the students will be able to

1. Illustrate various elementary concepts of computer architecture including, syntax ofregister transfer language, micro-operations, instruction cycle, and control unit.
2. Describe the design of basic computer with instruction formats & addressing modes
3. Explore various memory management techniques and algorithms for performing addition, subtraction and division etc.
4. Interpret the concepts of pipelining, multiprocessors, and inter processorcommunication.

Text Books:

1. Mano, Morris M., Computer System Architecture, Prentice Hall (1991) 3rd ed.
2. Hayes, J.P., Computer Architecture and Organization, McGraw Hill (1998) 3rd ed.

Reference Books:

1. Hennessy, J.L., Patterson, D.A, and Goldberg, D., Computer Architecture A Quantitative Approach, Pearson Education Asia (2006) 4th ed.
2. Leigh, W.E. and Ali, D.L., System Architecture: software and hardware concepts,South Wester Publishing Co. (2000) 2nd ed.

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HS-115L: UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY ETHICAL HUMAN CONDUCT

Course Code	**HS-115L**	**Credits-03**	**L-2, T-1, P-0**
Name of Course	**Universal Human Values-II: Understanding Harmony Ethical Human Conduct**		
Theory External Examination:	**Max. Marks: 60**	**Min. Marks :24**	**Time Allowed: 3 Hrs.**
Internal Assessment	**Max. Marks: 40**	**Min. marks: 16**	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

Pre-requisites: None. Universal Human Values 1 (Desirable)

1- COURSES ON HUMAN VALUES

During the Induction Program, students would get an initial exposure to human values through Universal Human Values-I. This exposure is to be augmented by this compulsory full semester foundation course.

Objectives of UHV-II Course

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value- based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

   Thus, this course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

Salient Features of the Course

The salient features of this course are:

1. It presents a universal approach to value education by developing the right understanding of reality (i.e. a worldview of the reality "as it is") through the process of self-exploration.

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2. The whole course is presented in the form of a dialogue whereby a set of proposals about various aspects of the reality are presented and the students are encouraged to self-explore the proposals by verifying them on the basis of their natural acceptance within oneself and validate experientially in living.
3. The prime focus throughout the course is toward affecting a qualitative transformation in the life of the student rather than just a transfer of information.
4. While introducing the holistic worldview and its implications, a critical appraisal of the prevailing notions is also made to enable the students discern the difference on their own right.

UNIT-1: Introduction to Value Education (6 lectures and 3 tutorials for practice session)
Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario Lecture 6: Method to Fulfill the Basic Human Aspirations Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT- 2: Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the Self and the Body
Lecture 8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of Self and Body
Lecture 9: The Body as an Instrument of the Self
Lecture 10: Understanding Harmony in the Self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the Self
Lecture 11: Harmony of the Self with the Body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of Self with the Body

UNIT- 3: Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect Lecture 16: Other Feelings, Justice in Human-to-Human Relationship Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT-4: Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence

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Text Books and Teachers Manual:

a. The Textbook
A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual
Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-

3-2-Reference Books

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

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HS-117L: DESIGN THINKING

Course Code	HS-117L	Credits-01	L-0, T-0, P-2
Name of Course	Design Thinking		
Theory External Examination:	Max. Marks: 60	Min. Marks :24	Time Allowed: 3 Hrs.
Internal Assessment	Max. Marks: 40	Min. marks: 16	
Continue Assessment (Based on sessional tests 50%) Tutorial/Assignment: 30%, Quiz/seminar:10%, Attendance:10%			

INSTRUCTIONS:

1. The question paper will consist of five sections A, B, C, D and E. Section E will be Compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C and D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.
2. Candidates are required to attempt five questions in all selecting one question from each of the section A, B, C and D of the question paper and all the subparts of the questions in sections E, Use of non-programmable calculators are allowed.

COURSE CONTENTS

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.

SECTION-I

Unit 1: An Insight to Learning

Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting

Unit 2: Remembering Memory

Understanding the Memory process, Problems in retention, Memory enhancement techniques

Unit 3: Emotions: Experience & Expression

Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers

SECTION-II

Unit 4: 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

Unit 5: Being Ingenious & Fixing Problem

Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving

SECTION-III

Unit 6: Process of Product Design

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design

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Unit 7: Prototyping & Testing
What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing
Unit 8: Celebrating the Difference
Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences

SECTION-IV
Unit 9: 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
Unit 10: Feedback, Re-Design & Re-Create
Feedback loop, 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".

Course Outcomes (CO):
Student will able to

1. Compare and classify the various learning styles and memory techniques and apply them in their engineering education
2. Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products
3. Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products
4. Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development
5. Perceive individual differences and its impact on everyday decisions and further Create a better customer experience

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CHM-101P: APPLIED CHEMISTRY LAB

Course Code	CHM-101P	Credits – 01	L - 0, T - 0, P - 2
Name of Course	APPLIED CHEMISTRY LAB		
Practical Internal Assessment	MM:30	Min. Marks :12	Total: 50 Marks
Practical External Assessment	MM:20	Min. Marks :8	

Course Objectives: This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

Laboratory Work:

- Electrochemical measurements: Experiments involving use of pH meter, conductivitymeter.
- Water Chemistry: Determination of hardness, alkalinity, DO, free chlorine, Chlorides, chromium,iron and copper in aqueous medium
- Properties of Liquids: Determination of Viscosity, Surface Tension
- Spectrophotometry: UV-Vis spectrophotometer related experiments
- Fuel's: Proximate Analysis of Coal
- Polymers: Preparation of Phenol/Urea-formaldehyde resins/ Biodegradable and conducting polymer
- Nanomaterials: Synthesis of nanoparticles of Au/Ag/NiO/ZnO/Iron Oxide

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