Four-Year Undergraduate Programme

Bachelor of Technology

Mechatronics Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Faculty of Engineering & Technology
Bachelor of Technology in Mechatronics Engineering

1. Vision of the Department

To be recognized for world-class technical education and research catering to the ever-changing industrial demands and social needs.

2. Mission of the Department

M1 To offer high-quality application-oriented education and prepare our graduates to become innovators in their profession.
M2 To pave the way to research and discovery in emerging disciplines and in related interdisciplinary areas.
M3 To inculcate communication skills, leadership, ethics and entrepreneurship among students for their continuous growth.
M4 To promote the establishment of centres of excellence in emerging areas of technology nurturing innovative ideas and kindle creativity among faculty and students.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Tech. Mechatronics Engineering curriculum enables graduates to attain.

PEO 1	Pursue successful career in engineering involving professional knowledge and skills for analysis, design and solution of real time engineering problems.
PEO 2	Excel in professional career with sound fundamental knowledge and pursue life-long learning including higher education and research.
PEO 3	Demonstrate interpersonal skills, leadership ability and team building to achieve organization goals and serve society with professional ethics and integrity.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	**Engineering knowledge:**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	**Problem analysis:**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	**Design/development of solutions:**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public

		health and safety, and cultural, societal, and environmental considerations.
PLO 4	**Conduct investigations of complex problems:**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PLO 5	**Modern tool usage:**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	**The engineer and society:**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	**Environment and sustainability:**	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	**Ethics:**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	**Individual and team work:**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	**Communication:**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	**Project management and finance:**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	**Life-long learning:**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	To demonstrate knowledge of statics, dynamics, and solid mechanics relevant to mechatronics Engineering.
PSO 2	To design and develop mechatronics components and systems.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	22
Semester-2	20
Semester-3	23
Semester-4	20
Semester-5	23
Semester-6	24
Semester-7	20
Semester-8	15
Total Credits:	**167**

Category wise Credit distribution of the programme	
Category	**Credit**
Major Core	79
Minor Stream	28
Multidisciplinary	22
Ability Enhancement Course	08
Skill Enhancement Courses	10
Value added Courses	02
Summer Internship	04
Research Project/Dissertation	14
Total Credits:	**167**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303105102	Programming for Problem Solving	4.00	3	2	-
2	303106101	Basic Electrical Engineering	4.00	3	2	-
3	303109102	Elements of Mechanical Engineering	4.00	3	2	-
4	303191101	Mathematics-I	4.00	4	-	-
5	303193103	Communication Skills	2.00	-	-	2
6	303192102	Elective - 1 (Engineering Physics-II)	4.00	3	2	-
		Total	**22.00**	**16**	**8**	**2**
Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
7	303100101	Workshop	2.00	-	4	-

8	303104105	Environmental Science	audit course	1	-	-
9	303104155	Mechanics of Solids	4.00	3	2	-
10	303107151	Basic Electronics	4.00	3	2	-
11	303109101	Engineering Graphics	4.00	2	4	-
12	303191151	Mathematics-II	4.00	4	-	-
	303193152	Advanced Communication & Technical Writing	2.00	-	-	2
		Total	**20.00**	**13**	**12**	**2**
Semester 3						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
13	303111203	Control Theory	3.00	3	-	-
14	303111204	Control Theory Lab	1.00	-	2	-
15	303113201	Analog and Digital Electronics	4.00	4	-	-
16	303113202	Analog and Digital Electronics Lab	1.00	-	2	-
17	303113203	Electrical Machines	3.00	3	-	-
18	303113204	Electrical Machines Lab	1.00	-	2	-
19	303113205	Engineering Thermodynamics	3.00	3	-	-
20	303113206	Product Realization	1.00	-	2	-
21	303191201	Complex Variables and PDE	4.00	4	-	-
22	303193203	Professional Communication Skills	2.00	-	-	2
		Total	**23.00**	**17**	**8**	**2**
Semester 4						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
23	303113251	Engineering Materials and Metallurgy	3.00	3	-	-
24	303113252	Engineering Materials and Metallurgy Lab	1.00	-	2	-
25	303113253	Theory of Machine for Mechatronics	2.00	2	-	-
26	303113254	Theory of Machine for Mechatronics Lab	1.00	-	2	-
27	303113255	Basics of Signal & Systems	3.00	3	-	-
28	303113256	Basics of Signal & Systems Lab	1.00	-	2	-
29	303113257	Microcontrollers and Interfacing	3.00	3	-	-
30	303113258	Microcontrollers and Interfacing Lab	1.00	-	2	-
31	303191251	Probability, Statistics and Numerical Methods	4.00	4	-	-
32	303193252	Professional Grooming and Personality Development	1.00	-	-	1
		Total	**20.00**	**15**	**8**	**1**
Semester 5						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**

33	303113301	Sensors and Transducers	3.00	3	-	-
34	303113302	Sensors & Transducers Laboratory	1.00	-	2	-
35	303113303	Manufacturing Process	3.00	3	-	-
36	303113304	Manufacturing Process Lab	1.00	-	2	-
37	303113305	Kinematics and Dynamics of Machines	3.00	3	-	-
38	303113306	Kinematics and Dynamics of Machines Lab	1.00	-	2	-
39	303122305	Integrated Circuits and Applications	3.00	3	-	-
40	203122306	Integrated Circuits and Applications Lab	1.00	-	2	-
41	303193304	Professionalism & Corporate Ethics	1.00	-	-	1
42		PEC 01(Compulsory Subjects :1)	3:00	3	-	-
43		PEC 01-LAB (Compulsory Subjects :1)	1.00	-	2	-
44		Open Elective (Compulsory Subjects :1)	2.00	2	-	-
		Total	**23.00**	**17**	**10**	**1**

PEC 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303113331	Power Electronics	3.00	3	-	-
2	303113333	Data Structure and Algorithms	3.00	3	-	-
3	303113335	Automobile Engineering	3.00	3	-	-

PEC 01-LAB

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303113332	Power Electronics Lab	1.00	-	2	-
2	303113334	Data Structure and Algorithms Lab	1.00	-	2	-
3	303113336	Automobile Engineering Lab	1.00	-	2	-

Open Elective 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303101331	Basic Aircraft Science	2.00	2	-	-
2	303104311	Disaster Preparedness and Planning	2.00	2	-	-
3	303105304	Cyber Security	2.00	2	-	-
4	303106346	Energy Science & Engineering	2.00	2	-	-
5	303107346	Fundamentals of Communication Engineering	2.00	2	-	-
6	303105489	Internet of Things	2.00	2	-	-
7	303109346	Renewable Energy Sources	2.00	2	-	-
8	303107346	Fundamentals of Communication Engineering	2.00	2	-	-

Semester 6

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
45	303101358	Minor Project	1.00	-	2	-

46	303113351	Industrial Automation	3.00	3	-	-
47	303113352	Industrial Automation Lab	1.00	-	2	-
48	303113353	Manufacturing Process II	3.00	3	-	-
49	303113354	Manufacturing Process - II Lab	1.00	-	2	-
50	303113355	Computer Aided Design and Analysis	3.00	3	-	-
51	303113356	Computer Aided Design and Analysis Lab	1.00	-	2	-
52	303122351	Hydraulic and Pneumatic Systems	3.00	3	-	-
53	303122352	Hydraulic and Pneumatic Systems Lab	1.00	-	2	-
54	303193353	Employability Skills	1.00	-	-	1
55		PEC 02 (Compulsory Subjects :1)	3.00	3	-	-
56		PEC 02-LAB (Compulsory Subjects :1)	1.00	-	2	-
57		Open Elective 02 (Compulsory Subjects :1)	2.00	2	-	-
		Total	**24.00**	**17**	**14**	**1**

PEC 02

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303113381	Fluid Power Engineering	3.00	3	-	-
2	303113383	Advanced Micro-Computing Systems	3.00	3	-	-
3	303113385	Mechanical Component Design	3.00	3	-	-

PEC 02-LAB

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303113382	Fluid Power Engineering Lab	1.00	-	2	-
2	303113384	Advanced Micro-Computing Systems Lab	1.00	-	2	-
3	303113386	Mechanical Component Design Lab	1.00	-	2	-

Open Elective 02

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	303100355	Engineering Ergonomics	2.00	2	-	-
2	303100354	Landscape Planning and Design	2.00	2	-	-
3	303100353	Fundamentals of Management	2.00	2	-	-
4	303100356	Corporate Social Responsibility	2.00	2	-	-
5	303104411	Innovation and Entrepreneurship	2.00	2	-	-
6	303100354	Constitution of India	2.00	2	-	-
7	303105392	Cyber Law & Ethics	2.00	2	-	-

Semester 7

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
58	303113401	Advanced Manufacturing System	3.00	3	-	-
59	303113402	Advanced Manufacturing System Lab	1.00	-	4	-
60	303113403	Autotronics	3.00	3	-	-

61	303113404	Autotronics Lab	1.00	-	2	-
62	303103406	Summer Internship	2.00	-	-	-
63	303103408	Project-I	6.00	-	14	-
64		PEC 03 (Compulsory Subjects :1)	3.00	3	-	-
65		PEC 03-LAB (Compulsory Subjects :1)	1.00	-	2	-
		Total	**20.00**	**9**	**24**	**-**
PEC 03						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303113431	MEMS and Nanotechnology	3.00	3	-	-
2	303113433	Finite Element Analysis	3.00	3	-	-
PEC 03-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303113432	MEMS and Nanotechnology Lab	1.00	-	2	-
2	303113434	Finite Element Analysis Lab	1.00	-	2	-
Semester 8						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
66	303113451	Robotics & AI	3.00	3	-	-
67	303113452	Robotics & AI Lab	1.00	-	2	-
68	303113454	Mechatronics Maintenance and Software Lab	1.00	-	2	-
69	303113456	Project-IV	6.00	-	12	-
70		PEC 04 (Compulsory Subjects :1)	3.00	3	-	-
71		PEC 04-LAB (Compulsory Subjects :1)	1.00	-	2	-
		Total	**15.00**	**6**	**18**	**-**
PEC 04						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303113481	Internet of Things	3.00	3	-	-
2	303113483	Vision Systems and Image Processing	3.00	3	-	-
PEC 04-LAB						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	303113482	Internet of Things Lab	1.00	-	2	-
2	303113484	Vision Systems and Image Processing Lab	1.00	-	2	-

1. Detailed Syllabus

Semester 1

(1)

a. **Course Name:** Programming for Problem Solving
b. **Course Code:** 303105102
c. **Prerequisite:** Requires Basic Knowledge of Computer
d. Rationale: This course is design to provide basic ideas of computer programming. This course also makes help to understand programming language. It will help to develop their logical abilities.
e. **Course Learning Objective:**

CLOBJ 1	Recognize and recall fundamental principles and organizations of computers, demonstrating a foundational understanding of computer architecture and design.
CLOBJ 2	Comprehend the concepts of computer programming languages, illustrating a grasp of syntax, semantics, and the essential components of programming languages.
CLOBJ 3	Develop algorithms for solving basic engineering problems, demonstrating the ability to apply theoretical knowledge to practical problem-solving scenarios.
CLOBJ 4	Demonstrate proficiency in the practical application of C programming by writing, compiling, and debugging programs, showcasing the ability to implement and troubleshoot code effectively.
CLOBJ 5	Evaluate and analyse complex computational programs written in C, demonstrating the capacity to assess and understand intricate solutions to computational challenges.
CLOBJ 6	Develop simple projects using the C programming language, showcasing creativity and application of learned principles to produce functional and practical software solutions.

f. **Course Learning Outcomes:**

CLO 1	Recognize the computer's basic principles and organizations.
CLO 2	Understand Concepts of Computer Programming Language.
CLO 3	Develop the algorithm for solving basic Engineering Problems.
CLO 4	Write, Compile and debug program with C Programming.
CLO 5	Analyse the Solved, Complex Computational Program written in C.
CLO 6	Develop simple projects using C Language.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr No.	Topics	Weightage (%)	Teaching Hours
1	**Number System:** Introduction and type of Number system, Conversion between number system, Arithmetic operations on number system, Signed and unsigned number system Software, Computer Languages and Computer Program	2	3
2	**Introduction to 'C' Programming:** Features of C language, structure of C Program, Flow Charts and Algorithms Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory.	3	3
3	**Constants, Variables and data Types:** Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, assigning values to variables, typedef, and defining symbolic constants.	5	2
4	**Operators and Expression:** Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associatively.	10	5
5	**Management Input and Output Operators:** Introduction, reading a character, writing a character, formatted input, formatted output.	5	2
6	**Control structure in C:** Decision Making & branching: Decision making with If &I. Else statements, If. Else statements (Nested …. Ladder), The Switch & go to statements, The turnery (? :) Operator Looping: The while statement, The break statement & The Do. While loop, The FOR loop, Jump within loops – Programs	15	4
7	**Array:** Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.	10	4
8	**String:** string, string storage, Built-in-string functions	10	3

9	**User-Defined Functions:** Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing.	**10**	**5**
10	**Structure and Unions:** Introduction, Structure definition, declaring and initializing Structure variables, Accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions	**10**	**5**
11	**Pointers:** Basics of pointers, pointer to pointer, pointer and array, Pointer to array, array of pointers, functions returning a pointer	**10**	**5**
12	**Dynamic memory allocation:** Introduction to Dynamic memory allocation, malloc (), calloc (), free (), realloc ()	**5**	**2**
13	**File Management in C:** Introduction to file management and its functions	**5**	**2**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Programming in ANSI C", (Textbook), By E. Balaguruswamy, Tata McGraw-Hill.
2. "C Programming: Test Your Skills", By Ashok Kamthane.
3. "Computer Fundamentals", By P.K. Sinha and Priti Sinha, BPB Publications, 4th Edition.
4. "Star C Programming", STAR Certification, C Certification Exam.
5. "Programming with C", By Byron Gottfried, Tata McGraw Hill Education.
6. "C The Complete Reference", By Herbert Schildt.
7. "Let Us C", By Yeshavant Kanetkar | BPB Publication.

Sr No.	Experiment List
1	Write a program to print HELLO FRIENDS!
2	Write a program that reads two nos. from key board and gives their addition, subtraction, multiplication, division and modulo.
3	Write a program to calculate area of circle, use Ω as symbolic constants.
4	Write a program to convert days into months and days.
5	Write a program which calculates the summation of three digits from the given 3-digit number.
6	Write a program to demonstrate enumerates data type.
7	Write a program to compute Fahrenheit from centigrade.

8	Write a program to calculate simple interest. Read the price of item in decimal form e.g. 12.50 and separate Rs and Paise from the given value e.g. 12 rupees and 50 paise.
9	Write a program to find the largest of the three nos. using Nested-If-Else statement.
10	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
11	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
12	Write a C program to enter a character and to check whether it is a small letter or it is a capital letter or it is a digit or it is a special symbol.
13	Write a program to read marks from keyboard and your program should display equivalent grade according to following table. Marks Grade,100-80 Dist., 60-79 First Class, 35-59 Second Class.
14	Write a program to read marks of a student from keyboard whether the student id pass (if).
15	Write a program to find the sum of first N odd numbers.
16	Write a program using while loop construct which finds the factorial of a given integer number.
17	Write a C program using do « while and for loop constructs to reverse the digits of the number.
18	Write a program to demonstrate use of Switch- Break Statement.
19	Write a program to find out all the numbers divisible by 5 and 7 between 1 to 100.
20	Check for Armstrong number. A number is Armstrong if sum of cube of every digit is same as the original number. E.g. 153=13+53+33=153
21	Write a program to print the output of bellow series. 1! +2! +3! +4! +..... n!
22	Write a program to print the following outputs using for Loop. 1 *, 12 **, 123 ***
23	Write a program to print the following outputs using for Loop. (a) 1 (b) 321 21 21 321 1
24	Write a program which sorts 10 numbers into ascending order.
25	Write a program to find maximum element from 1-D array.
26	Write a program to find number of odd and even elements from the 1-D array.
27	Write a program add two 2x2 matrices.
28	Write a program to count number of positive, negative and zero elements from 3x3 matrix.
29	Write a function for the following operations on string: Copy one string to another, Comparing two strings, Adding a string to the end of another.
30	Write a program to count vowels from an entered String.
31	Write a program which finds whether a string is a palindrome or not.
32	Write a program to find factorial of a number using recursion.
33	Write a program that used user defined function Swap () and interchange the value of two variable.
34	Write a function to return 1 if the number is prime otherwise return 0.

35	Define a structure type, personal that would contain person name, date of joining and salary.
36	Define a structure called cricket that will describe the following information: Player name Team name Batting average
37	Write a program to add two numbers using pointers.
38	Write a program to swap two numbers using pointer
39	Write a program to illustrate reading files contents.
40	Write a program to illustrate the use of fgets ()

(2)

a. **Course Name:** Basic Electrical Engineering
b. **Course Code:** 303106101
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Basic Electrical Engineering knowledge is fundamental as it provides a strong foundation for various engineering disciplines, promotes problem-solving skills, supports innovation, and opens doors to diverse career opportunities.
e. **Course Learning Objective:**

CLOBJ 1	Gain familiarity with electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.
CLOBJ 2	Solve problems related to Alternating current, alternating voltage, etc, Demonstrate a clear understanding of Pure R, L C circuit and combination of RLC, Series and Parallel combination of R, L and C, etc
CLOBJ 3	Acquire knowledge of the resistor, capacitor, and inductor and their performance characteristics for series and parallel connections.
CLOBJ 4	Understand different single phase and three phase circuits.
CLOBJ 5	Demonstrate a clear understanding of the basic concepts, working principles and applications of transformer, DC machines and AC machines.
CLOBJ 6	Study the use of LT Switch Gear, Fuse, MCB, ELCB etc

f. **Course Learning Outcomes:**

CLO 1	Understand electrical current, potential difference, power and energy, sources of electrical energy and elements of electrical circuit.
CLO 2	Solve basic electrical circuit problems using various laws and theorems
CLO 3	Understand the role of resistor, capacitor and inductor and their performance characteristics for series and parallel connections.
CLO 4	Discuss three phase-balanced circuits.
CLO 5	Understanding the basic concepts and working principles of transformers, DC machines and AC machines.
CLO 6	Acquire knowledge about electrical installations

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**DC Circuits** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Mesh and Node analysis, Simplifications of networks using series and parallel combinations and star-delta conversions. Superposition, Thevenin and Norton Theorems.	22	10
2	**AC Circuits** Sinusoidal voltages and currents, their mathematical and graphical representation, Concept of instantaneous, peak (maximum), average and R.M.S. values, frequency, cycle, period, peak factor and form factor, phase difference, lagging, leading and in phase quantities and phasor representation. Rectangular and polar representation of phasors, examples based on theory. Study of A.C. circuits consisting of pure resistance, pure inductance, pure capacitance and corresponding voltage-current phasor diagrams and waveforms. Development of the concept of reactance, the study of series R-L, R-C, R-L-C circuit and resonance, study of parallel R-L, R-C and R-L-C circuit, concept of impedance, admittance, conductance and susceptance in case of above combinations and relevant voltage-current phasor diagrams, the concept of active, reactive and apparent power and power factor, examples based on theory. Concept of three-phase supply and phase sequence. Voltages, currents and power relations three-phase have balanced star-connected loads and delta-connected loads along with phasor diagrams, Power and power factor measurement in balanced three-phase circuits (one, two and three wattmeter methods), examples based on theory.	33	15
3	**Transformers** Magnetic effect of an electric current, right-hand thumb rule, Concept of mmf, flux, flux density, reluctance,	20	9

	permeability and field strength, their units and relationships, comparison between electrical and magnetic parameters. Fleming's left-hand rule. self and mutual inductance, Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.		
4	**Electrical Machines** Construction, working and application of DC Motor and Generator. Generation of 3 phase rotating magnetic fields, Construction and working of a three-phase and Single-phase induction motor and its types. Construction and working of Synchronous generator.	**15**	**7**
5	**Electrical Installations** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries.	**10**	**4**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Electrical Engineering Fundamentals, By V. D. Toro, Prentice Hall India, Pub. Year 1989
2. Basic Electrical Engineering, By D. C. Kulshreshtha, McGraw Hill
3. Fundamentals of Electrical Engineering, By Leonard S. Bobrow, Oxford University Press, Pub. Year 1996
4. Electrical and Electronics Technology, By E. Hughes Pearson, Pub. Year 2010
5. Basic Electrical Engineering, By D. P. Kothari and I. J. Nagrath, Tata McGraw Hill, Pub. Year, 2010
6. A textbook of Electrical Technology Volume 1&2, By B. L. Theraja, S. Chand Publication

j. Experiment List:

Sr. NO.	Experiment List
1	To Study about Various Electrical and Electronics Symbols and demonstrate various measuring instruments used in Basic electrical Engineering laboratory.
2	To Perform and Solve Electrical Networks with Series and Parallel Combinations of Resistors Using Kirchhoff 's Laws.
3	To Obtain Capacitance, Power and Power Factor of the Series RL Circuit with AC Supply Using Phasor Diagram.
4	To Obtain Capacitance, Power and Power Factor of the Series RC Circuit with AC Supply Using Phasor Diagram.

5	To Obtain Capacitance, Power and Power Factor of the Series RLC Circuit with AC Supply Using Phasor Diagram.
6	Verification of superposition theorem with dc source
7	Verification of Thevenin's theorem with dc source
8	Verification of Norton's theorems in dc circuits
9	Verification of Current and Voltage Relations in Three Phase Balanced Star and Delta Connected Loads.
10	Find out the Efficiency and Voltage Regulation of Single-Phase Transformer by Direct Load Test.

(3)

a. **Course Name:** Elements of Mechanical Engineering
b. **Course Code:** 303109102
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level
d. **Rationale:** Elements of Mechanical Engineering Course Provide students with a comprehensive foundation in the fundamental principles and concepts that form the backbone of mechanical engineering for various Engineering disciplines.
e. **Course Learning Objective:**

CLOBJ 1	Identify and basic mechanical components such as gears, bearings, Pumps, Compressor, boiler, I.C Engines.
CLOBJ 2	Understand various laws and behaviour of fluid at different conditions.
CLOBJ 3	Illustrate the operational mechanisms through diagrams, models, or practical demonstrations.
CLOBJ 4	Demonstrate construction and working principles of diverse mechanical devices, such as engines, pumps, and compressors.
CLOBJ 5	Evaluate basic problems related to I.C engine, pumps, compressors and fluids.
CLOBJ 6	Analyse and discuss the interactions and relationships between various mechanical elements within a system

f. **Course Learning Outcomes:**

CLO 1	Identify basic mechanical components and their functions.
CLO 2	Understand basic Properties and behaviour of various fluids.
CLO 3	Understand Construction and working of various mechanical devices
CLO 4	Apply fundamental principles to solve basic mechanical engineering problems

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Basics of Thermodynamics** Prime Movers - Meaning and Classification; Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Internal Energy, Enthalpy, Specific Volume; Thermodynamics – Definition: Change of State, Path, Process, Cycle, Thermodynamic systems, Statement of Zeroth Law, First Law and Second Law of Thermodynamics and its Applications.	10	5
2	**Properties of Gases** Gas Laws, Boyle's law, Charles law, Combined gas law; Gas Constant, Relation between Cp and Cv Constant Volume Process; Constant Pressure Process; Isothermal Process; Adiabatic Process; Poly-tropic Process. Examples based on above topics.	15	6
3	**Properties of Steam** Types of Steam and Steam formation; Specific Enthalpy; Specific Volume; Dryness Fraction of Steam; Measurement of Dryness Fraction; Steam Table. Examples based on above topics.	15	6
4	**Heat Engines** Definition of Heat Engine; Classification of Heat Engine; Carnot Cycle, Rankine Cycle, Otto Cycle and Diesel Cycle. **Internal Combustion Engines:** Two Stroke Petrol and Diesel Engine; Four Stroke Petrol and Diesel Engine; Measurement of Indicated Power and Brake Power: Numerical on calculation of Mechanical, Thermal and Volumetric Efficiency. Examples based on above topics.	20	10
5	**Energy Conversion Devices** **Steam Generators:** Definition and Classification; Cochran, Lancashire, Locomotive, Babcock and Wilcox Boiler: Construction and Working; Boiler Mounting and Accessories. **Refrigeration and Air Conditioning:** Meaning of Refrigeration; Vapor Compression Refrigeration Cycle; Vapor Absorption Refrigeration Cycle; Air conditioning; Window Air Conditioning and Split Air Conditioning.	20	5
6	**Pumps And Air Compressors** **Pumps** Definition, Classification and Application of Pumps; Types and Operation of Rotary pump, Reciprocating Pump, Centrifugal Pump. **Air Compressors** Definition, Classification and Application of Compressors; Types and Operation of Rotary and Reciprocating Air Compressor.	10	5
7	**Motion And Power Transmission Devices** Shaft and Axle; Belt Drive; Chain Drive; Friction Drive; Gear Drive; Clutch, Coupling and Brake.	5	4
8	**Conventional And Non-Conventional Energy Sources** Introduction and Classification of Energy Sources; Conventional	5	4

	Energy Sources E.g. Solid, Liquid, Gaseous and Nuclear fuels; Calorific Value of Fuels; Non-Conventional Energy Sources E.g. Solar Energy, Wind Energy, Hydro Power, Biomass and Biomass Energy; Comparison of Conventional & Non-Conventional Energy Sources.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Elements of Mechanical Engineering", By S.B. Mathur, S. Domkundwar, Dhanpat Rai & Sons Publications.
2. "Thermal Engineering, By R.K Rajput", Laxmi Publications.
3. "Thermal Science and Engineering", By Dr. D. S. Kumar, S. K. Kataria and sons Publishers.
4. "Basic Mechanical Engineering", By T. S. Rajan, Wiley Eastern Ltd
5. "Fundamental of Mechanical Engineering", By G. S. Sawhney, PHI Publication New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Demonstration and study of construction and working of Petrol Engine Model.
2	Demonstration and study of construction and working of Diesel Engine Model.
3	Determination of brake thermal efficiency of an I. C. Engine.
4	Demonstration and study of construction and working of various types of boiler Models.
5	Study of construction and working of different boiler mountings and accessories.
6	Demonstration on construction and working of different types of pumps.
7	Demonstration on construction and working of different types of air compressors.
8	Demonstration on vapour compression refrigeration cycle and vapour absorption refrigeration cycle.
9	Demonstration on construction, working and applications of different types of coupling, clutch and brake.
10	Demonstration on construction, working and applications of motion and power transmission devices.

(4)

a. **Course Name:** Mathematics-I
b. **Course Code:** 303191101
c. **Prerequisite:** Knowledge of Mathematics up to 12th science level
d. **Rationale:** The Mathematics I syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and matrix algebra, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Develop a deep understanding of first-order linear and nonlinear PDEs, including the application of Charpit's Method. Proficiently solve second and higher-order linear PDEs using complementary function and particular integral methods. Apply separation of variables method to solve problems in Cartesian coordinates.
CLOBJ 2	Apply PDEs to model and analyse physical phenomena such as heat conduction, wave propagation, and electrostatics. Gain proficiency in formulating initial and boundary conditions and solve problems related to the Heat, Wave, and Laplace equations. Utilize visualization tools to interpret and communicate results.
CLOBJ 3	Comprehend and apply fundamental probability concepts, including probability spaces, conditional probability, and independence. Analyse and solve problems involving discrete random variables, the multinomial distribution, Poisson approximation, and infinite sequences of Bernoulli trials. Explore the properties of continuous random variables, distribution functions, and densities, with a focus on normal, exponential, and gamma distributions.
CLOBJ 4	Develop statistical analysis skills covering basic statistics, measures of central tendency, and probability distributions (Binomial, Poisson, and Normal). Evaluate statistical parameters for these distributions. Perform correlation and regression analyses, including rank correlation. Apply the method of least squares for curve fitting, specifically for straight lines, second-degree parabolas, and more general curves.
CLOBJ 5	Apply probability and statistics concepts to real-world scenarios. Analyse and interpret statistical data to draw meaningful conclusions. Use probability theory to make informed predictions and decisions in various fields.
CLOBJ 6	Enhance problem-solving and critical thinking skills through the application of mathematical and statistical methods. Demonstrate the ability to approach complex problems systematically, analyse them, and arrive at logical solutions.

f. Course Learning Outcomes:

CLO 1	Develop understanding of fundamental mathematical concepts
CLO 2	Formulate and solve mathematical models for real-world engineering problems,
CLO 3	Integrate knowledge from different mathematical topics to analyse and solve complex engineering problems
CLO 4	Critically analyse mathematical results, interpret their engineering significance, and make informed decisions based on mathematical outcomes, fostering a deeper understanding of the subject.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Improper Integral & Application of Definite Integral:** Evaluation of definite and improper integrals, Beta and Gamma functions and their properties Area bounded by curves in Cartesian and Polar form, Area of a region bounded by function, Area of a region bounded by curves in Parametric form, Volume by slicing, Volume of solid by revolution.	8	5
2	**First order Ordinary Differential equation:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type, Applications	15	9
3	**Matrices:** Matrices & Determinants with Properties, Linear Independence, Rank of Matrix, System of Linear Equations, Consistency of System, Solution of system of Linear Equations by Gauss Jordan and Gauss-Elimination Method, Eigen values, Eigenvectors, Symmetric, Skew-symmetric, and orthogonal Matrices, Eigen bases, Diagonalization, Cayley Hamilton Theorem and its Applications, Diagonalization, Orthogonal Transformation, Quadratic form.	25	15
4	**Sequences and Series:** Basic of Sequences, Bounded and Monotonic Sequences, Series, Convergence of sequence and series, Geometric series, P- series, Cauchy's Integral Test, Comparison Test, Alternating Series, Absolute and	17	10

	Conditional convergence, Ratio test, Cauchy's Root Test, Power series, Taylor's and Maclaurin's series.		
5	**Fourier Series:** Fourier Series of 2 periodic functions, Dirichlet's conditions for representation by a Fourier series, Fourier Series of a function of period 2, Fourier Series of even and odd functions, Half range series.	**10**	**6**
6	**Multivariable Calculus (Differentiation):** Functions of Several Variables, Limit, Continuity, Partial Derivatives, Homogeneous function, Euler's Theorem for homogeneous function, Modified Euler's Theorem, Chain Rule, Implicit function, Jacobian, Tangent plane and Normal line, Maximum and Minimum Values, Lagrange's Multiplier, Taylor's and Maclaurin's Series for functions of two variables.	**25**	**15**
	Total	**100**	**60**

i. Text Book and Reference Book:

1. "Calculus and Analytic Geometry", (Textbook), By G.B. Thomas and R.L. Finney, Addison Wesley
2. "Calculus with early transcendental functions", By James Stewart, Cengage Learning
3. "Higher Engineering Mathematics" By B. S. Grewal, Khanna Publication.

a. **Course Name:** Communication Skills
b. **Course Code:** 303193103
c. **Prerequisite:** Knowledge of English Language studied till 12th standard.
d. **Rationale:** Basic Communication Skills are essential for all Engineers.
e. **Course Learning Objective:**

CLOBJ 1	Students will demonstrate the ability to communicate ideas clearly and effectively.
CLOBJ 2	Students will develop strategies for building positive interpersonal relationships, fostering effective collaboration and teamwork.
CLOBJ 3	Students will develop active reading skills, including the ability to comprehend, interpret, and respond appropriately to written messages.
CLOBJ 4	Students will exhibit proficiency in written communication, crafting clear, concise, and well-organized messages across various formats (Ex: Book review, Picture Description, Picture Connectors).
CLOBJ 5	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content, and confident delivery.
CLOBJ 6	Students will be able to understand and analyse the common grammatical errors.

f. **Course Learning Outcomes:**

CLO 1	Understand the importance of creative and critical thinking.
CLO 2	Expand vocabulary with proper pronunciation.
CLO 3	Comprehend the basics of English grammar.
CLO 4	Read & write effectively for a variety of contexts.
CLO 5	Develop confidence in public speaking skills.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	**-**	**100**	-	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr No	Content	Weightage (%)	Teaching Hrs.
1	**Crazy Scientist**: The students will be taught the importance of invention and innovation using some examples that changed the world theway it worked.	5	2
2	**Phonetics**: IPA Introduction (listening tracks), Phonic Sounds, Pronunciation Practice including transcription.	10	4
3	**Vocabulary Building & Word Formation Process**: Compounding, clipping, blending, derivation, creative respelling, coining and borrowing Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided)	10	2
4	**Speaking Activity: Role plays on Critical Thinking (Life boat)** This activity topic gears towards making students do role play based on various scenarios. It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on toenact it. It aims to improve students' convincing skills.	10	4
5	**Picture Description & Picture Connector**: Enable students to use vocabulary and useful expression to describe the picture. In this class the students will be trained to form logical connections between a set of pictures which will be shared withthem. This geared towards building creativity and presentation skills.	15	4
6	**Mine Activity: Usage of Preposition**: Students will learn to use proper propositions by active participation in the activity.	8	2
7	**Worksheets on Identifying Common Errors in Writing:** Sentence structure, Punctuations, Subject-Verb Agreement, Noun-Pronoun Agreement	12	2
8	**Reading Skills**: The art of effective reading and its various strategies to be taught to the learners and practice exercises be given onreading comprehension.	10	2
9	**Speech and spoken Exchanges; Extempore**: Students will learn the correct usage of spoken language as different from the written form. It will help the students in extempore speech. This will be done by making the students give variety of impromptu speeches in front of the class: 1 minute talk onsimple topics. To change the average speakers in the class to some of thebest Orator.	10	4
10	**Book Review**: The learners will identify the central idea of the book, author's style and approach towards the book. This will enable the learners to express their point of view and hone their creativity and writing skills.	10	4
	Total	**100**	**30**

i. Reference Books:

1. Understanding and Using English Grammar Betty Azar & Stacy Hagen; Pearson Education
2. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
3. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press
4. Technical Communication: Principles And Practice Sangeetha Sharma, Meenakshi Raman; Oxford University Press.
5. Practical English Usage MICHAEL SWAN.

6. A Remedial English Grammar for Foreign Student F.T. WOOD.
7. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition.
8. Oxford Practice Grammar, John Eastwood; Oxford University Press.

a. Course Name: Engineering Physics-II
b. Course Code: 303192102
c. Prerequisite: Knowledge of Physics and some basic concepts in Mathematics like differentiation, integration, limit, differential equation, vector calculus up to 12thscience level.
d. **Rationale**: Knowledge of physics is essential for all Engineering branch because physics is the foundation subject of all the branches of engineering and it develops scientific temperament and analytical capability of engineering students. Comprehension of basic physics concepts enables the students to solve engineering problem logically and develop scientific approach

e. Course Learning Objective:

CLOBJ 1	Understand the basics of quantum mechanics, including Schrodinger's equations and the physical significance of wave functions.
CLOBJ 2	Apply the Schrödinger equation to analyse particles in one-dimensional potential boxes, emphasizing practical implications and tunnelling effects.
CLOBJ 3	Master concepts of energy bands, semiconductor classification, E-k diagrams, and semiconductor device analysis including P-N junction diodes.
CLOBJ 4	Comprehensively understand material classification, focusing on magnetic materials, nanomaterials, and analysing physical, thermal, electrical, optical, and magnetic properties.
CLOBJ 5	Gain expertise in laser principles, types, and applications, as well as fibre optics principles and applications. Understand optoelectronic devices, their functionalities, and practical applications.

f. Course Learning Outcomes:

CLO 1	Formulate and conceptualize various theoretical aspects and the physical phenomena at atomic level
CLO 2	Analyse the optical transition processes in semiconductors and identify the materials useful in optoelectronic devices.
CLO 3	Understand the fabrication and applications of low dimensional semiconductor devices.
CLO 4	Acquire proficiency in experimental techniques used for studying nanoscale systems, including microscopy and spectroscopy.
CLO 5	Master the principles of quantum mechanics and their application to nanoscale systems.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No	Topics	Weightage (%)	Teaching Hours
1	**UNIT-I: Modern Physics** Introduction about quantum Mechanics, Schrodinger's equations, Time dependent and Time Independent Wave Equation, Physical Significance of the wave Function, Application of Schrodinger equation in particle in One Dimensional Potential Box and Tunnelling effects.	20	9
2	**UNIT-II: Band theory& Semiconductors** Energy bands in solids, Classification of Materials into, Semiconductors & Insulators, Density of state, E-k diagram, Kronig-Penny model (to introduce origin of band gap), Effective mass. Direct and indirect band gap. Carrier Concentration in semiconductors, Fermi Level in Intrinsic and Extrinsic Semiconductors, P-N junction diode, Ohmic and Schottky Junction.	20	9
3	**UNIT-III: Materials** Classification of materials: Magnetic materials, Nanomaterials based on semiconductors and metal oxides, Basic characteristic properties of nanomaterials, Novel Materials. Physical, Thermal, Electrical, Optical and Magnetic properties of materials.	20	9
4	**UNIT-IV: Laser and Fiber Optics** Lasers: Interaction of radiation with Matter, Absorption, Spontaneous and Stimulated emission, Characteristics of Lasers, Types of Lasers: Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers. Fiber Optics: Principle and Structure of Optical Fiber, Numerical Aperture of fiber, Types of Optical Fibers, Attenuation in Optical Fibers, Applications of Optical Fibers**.**	20	9
5	**UNIT-V: Devices** Optoelectronic Devices: Photoconductive cell, photovoltaic cell, Photodiode, Phototransistor, LED, IR emitters, Opto coupler, X-ray diffractometer, Quantum devices and their applications.	20	9
	Total	100	45

i. Text books:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. Engineering Physics — HK Malek and A. K. Singh- Mc Graw Hill Publication.
5. Semiconductor Optoelectronic Devices- P. Bhattacharya-Prentice Hall of India.
6. Fundamentals of Physics- Halliday, Resnick and Walker.

Semester 2

(1)

a. **Course Name:** Workshop
b. **Course Code:** 303100101
c. **Prerequisite:** Basic knowledge of drawing and machining.
d. **Rationale:** The workshop practice is the backbone of the real industrial trades which helps to develop and enhance relevant technical hands-on experience of using various tools and instruments related to various trades. The use of workshop practices in day to day industrial as well domestic life helps to solve the problems. Further, it also deals with basic introduction of system components of electrical and electronic systems, and provides hands on practice in assembling, interconnecting, testing, and repairing such system by making use of various tools used in electrical and electronic workshop. Electronic systems are built on printed circuit board (PCB) and breadboard. One need to use source instruments (power sources and signal sources), and appropriate measuring instruments to study behaviour of a system.

e. **Course Learning Objective:**

CLOBJ 1	Provide an overview of the principles, scope, and importance of mechanical engineering, including its various sub-disciplines and applications.
CLOBJ 2	Emphasize and enforce safety protocols, practices, and procedures to ensure a safe working environment within a mechanical workshop.
CLOBJ 3	Measurement Techniques and Instruments: Familiarize students with various measurement techniques and instruments used in mechanical engineering, emphasizing precision and accuracy in measurements.
CLOBJ 4	Introduce students to basic manufacturing processes such as machining, casting, forming, and welding, providing insights into how different materials are shaped and manipulated.
CLOBJ 5	Hands-on Experience with Tools and Equipment: Familiarize students with basic tools, machines, and equipment commonly used in mechanical engineering through hands-on activities and demonstrations in a workshop setting.

f. **Course Learning Outcomes:**

CLO 1	Comprehend the safety measures required to be taken while working in workshop.
CLO 2	Select the appropriate tools required for specific operation.
CLO 3	Understand the different manufacturing technique for production out of the given raw material.
CLO 4	Understand applications of machine tools, hand tools and power tools.
CLO 5	Understand the importance of the safety measures to be taken while working in the laboratory and safety standards
CLO 6	Understand working principle of various electrical & electronics measurement equipment. Also, the safety measures to be taken while working in the laboratory and safety standards.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
-	-	4	2	-	-	40	-	60	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Text Book and Reference Book:

1. Electronic Principles by Albert Paul Malvino.
2. Electronic Devices by Thomas L. Floyd, Prentice Hall "Linear Systems and Signals" by B.P. Lathi.
3. Electronic Devices and Circuits by David A. Bell.
4. Electronic Devices and Circuits by Jacob Millman and Halkias.
5. Shop Theory by Anderson James & Earl E. Tatro.
6. Workshop Technology by Bava H. S.
7. Elements of Workshop Technology Vol. I By Hajra Chaudhary S.K.
8. Workshop Technology by Chapman, W.A.J. ELBS.
9. Basic Machine Shop Practice Vol. I & II By Tejwani, V.K.
10. Workshop Technology Vol. I & II By Arora, B.D.
11. Signals and Systems" by Simon Haykin and Barry Van Veen.

i. Experiment List:

Exp. No.	Name of the Experiment
1	Study of Digital Multi meter and Measurement of voltage, current, frequency, phase difference, power, power factor for single phase supply using Digital Millimeter.
2	To study about safety, Electric shock, First aid for electric shock and other Hazards of electrical Laboratories and Safety rules.
3	Identification and symbolic representation of basic passive components
4	Understanding of working and specifications of CRO and Function generator
5	Identification, symbolic representation and testing of various electronics components (including SMD).
6	To understand working and specifications of DC regulated Power supply.
7	Understanding soldering techniques and practicing proper soldering and de-soldering.
8	Overview of PCB layout designing and fabrication.
9	Study of different types of cables, wires, probes, connectors
10	To understand series & parallel type of connections and to perform Bulb wiring, Fan wiring, Tube-light wiring
11	To perform staircase wiring, double stair case wiring, and Go-down wiring.

Exp. No.	Name of the Experiment
12	Demonstration of Fuse, MCB along its operation and study of ELCB.
13	Prepare installation diagram for a newly built room, Simple room wiring with one fan, one tube-light and one bulb with switch board
14	Introduction to Workshop Layout and Its Importance
15	Introduction to Industrial Safety
16	Introduction to Measuring Instruments
17	Fitting and Drilling Practice
18	Carpentry Practice
19	Sheet Metal Practice
20	Smithy Practice
21	Metal Joining Processes: Welding and Soldering Practice
22	Plumbing Practice
23	Metal Cutting on Lathe machine.

(2)

a. **Course Name:** Environmental Science
b. **Course Code:** 303104105
c. **Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level and Biology up to 10th science level
d. **Rationale:** Basic knowledge of the environment is essential for all human beings for a good life and sustainable existence
e. **Course Learning Objective:**

CLOBJ 1	Apply systems thinking to analyse the city as a system, demonstrating application
CLOBJ 2	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 3	Identify sources and stressors of water resources, demonstrating understanding
CLOBJ 4	Analyse the causes, effects, and control measures of population explosion

f. **Course Learning Outcomes:**

CLO 1	Understand the interrelation and interdependency of organisms and their interactions with the environment
CLO 2	Identify eco-friendly measures in engineering projects
CLO 3	Understand preventive steps for environmental protection.
CLO 4	Act as a responsible individual who is aware of efficient usage of resources and securing sustainable development

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**-**	**-**	**50**	**-**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**ENVIRONMENTAL HEALTH, ECOLOGY AND QUALITY OF LIFE** Environmental education: Objective and scope, Impact of technology on the environment, Environmental disasters: Case studies, Global environmental awareness to mitigate stress on the environment, Structure and function of an ecosystem, Ecological pyramids, Pyramid of number, Pyramid of energy and pyramid of biomass.	**25**	**7**
2	**POLLUTION PREVENTION** Air & Noise pollution - Sources & their Effects, Case studies of Major Catastrophes, Structure and composition of the atmosphere, Water, Soil, Marine, Thermal & Marine Pollution: The story of fluoride contamination, Eutrophication of lakes, control measures, Measuring water quality: Water quality index, Waste water treatment (general) primary, secondary and tertiary stages, Municipal Solid waste management: Sources and effects of municipal waste, Biomedical waste, Hazardous waste	**25**	**6**
3	**POPULATION GROWTH, GLOBAL ENVIRONMENTAL CHALLENGES & LATEST DEVELOPMENTS** Population Explosion - Causes, Effects and Control, an International initiative in population-related issues, Urbanization, Growth of the world's large cities, Water resources: Sources of water, Stress on water resources, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Variation in concentrations of GHG gases in ambient air during last millennium, Role of Environmental Information System (ENVIS) in India and similar programs run by EPA(USA), Role of soft tools like Quantum GIS, Autodesk Building Information Modelling (BIM) and City Finance Approach to Climate-Stabilizing Targets (C- FACT), Life Cycle Assessment, Bioinformatics and Optimization tools for sustainable development.	**27**	**7**
4	**SMART CITIES** **Introduction to smart cities -** about smart cities, what is a smart city, world urbanization, case studies of Songdo, Rio De Janeiro, what makes cities smart. **City as a system of systems –** Introduction, systems thinking, Milton Keynes Future Challenges, Rich picture as city challenges, Wicked problems, Development of smart city approach – core elements, open data, sustainability, privacy and ethics, development processes.	**33**	**10**

	Smart Citizens – Their role, engaging citizens, IES Cities, Energy systems, Approaches for Citizen Engagement, co- creating smart cities, cities unlocked, living labs, city problems, crowdsourcing ideas, redesigning cities for citizens, all age-friendly cities, mobility on demand, motion maps. **Infrastructure, Technology and Data –** urban infrastructure and its technology, future of lighting, IoT, connected objects, sensing the city, NOx eating paints and air quality sensors, safest, smart citizen kit, sensing your city, Sensored City, Cyber security for data power, open, shared and closed data, satellite data, open data revolution, Smart City Project Data **Innovation –** smart innovations, smart city ecosystem, data-driven innovations for smart cities **Standards and Capacity Building –** the role of Standard, BSI smart city Standards, HyperCat, ITU Smart Sustainable cities, Smart City Readiness, Lessons Learnt from Amsterdam **Smart Measurements -** metrics and indicators, city indicators, WCCD data portal, value proposition, integrated reporting, smart city learning and education, urban data school.		
	Total	**110**	**30**

i. Text Book and Reference Book:

1. "Environmental Studies for Undergraduate Courses", (Textbook), By Dr Erach Bharucha. | Orient BlackSwan | Second Edition, Pub. Year 2013.
2. "Basics of Environmental Studies", By U K Khare.
3. "Environmental Studies" By Anindita Basak.
4. "Environmental Sciences", By Daniel B Botkin & Edward A Keller, John Wiley & Sons
5. "Air Pollution", By M N Rao, H. V N Rao, McGraw Hill Publishing Company Limited, New Delhi
6. "Environmental Engineering" By Howard S. Peavy, Donald R. Rowe, George Tchobanoglous | McGraw-Hill

(3)

a. **Course Name:** Mechanics of Solids
b. **Course Code:** 303104155
c. **Prerequisite:** System of units, Laws of motion, Basic idea of force, Concept of centroid Fundamentals of stress, strain and their relationships
d. **Rationale:** Mechanics of Solids is conceptual applications of principles of mechanics in Engineering.
e. **Course Learning Objective:**

CLOBJ 1	Comprehend the concepts of stress, strain, and deformation in solid materials under various loading conditions, and apply this understanding to analyse structural behaviour.
CLOBJ 2	Gain insight into the mechanical properties of materials such as elasticity, plasticity, and failure mechanisms, and their implications in designing resilient and safe structures.
CLOBJ 3	Analyse structural components, including beams, columns, and trusses, under different loading scenarios using principles of mechanics of solids, determining stresses, and deformations.
CLOBJ 4	Develop proficiency in constructing shear force and bending moment diagrams to understand internal forces and moments in structural elements, crucial for design and analysis.
CLOBJ 5	Calculate deflections and assess stability criteria for structural elements, recognizing critical conditions that impact structural integrity and safety.
CLOBJ 6	Apply principles of mechanics of solids to design structural elements, ensuring they meet safety standards, considering factors such as material selection, loading conditions, and design codes.

f. **Course Learning Outcomes:**

CLO 1	Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of Engineering.
CLO 2	Determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.
CLO 3	Apply principles of statics to determine reactions & internal forces in statically determinate beams.
CLO 4	Know basics of friction and its importance through simple applications.
CLO 5	Understand behaviour & properties of engineering materials.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**INTRODUCTION:** Forces/Equilibrium of Rigid body, Scalar and vectors, system of forces, resultant force, Statics of particles. Free-body diagrams. Equilibrium ofparticle in two dimensions, Resultants of three or more concurrent forces, Resolution of a force into components. Rectangular components of a force. Resultants by rectangular components, Concurrent force system in space: Resolution of a force into rectangular components in space, Coplanar Non-Concurrent Force Systems, Moments about Points and Axes, Equilibrium, Non-coplanar Non-concurrent Forces.	15	8
2	**CENTROID MOMENT OF INERTIA:** Distributed forces: Centroid and centre of gravity. Determination of centroid of lines and areas using integral technique, Determination of centroid of composite wires and areas, Centroid of volumes. Theorems of Pappus-Guldinus and its applications, Second moment of areas, Definition of moment of inertia. Determination of moment of areas by integration, Parallel axis theorem for Moment of Inertia. MI of composite areas, Concept of Mass moment of inertia of bodies.	15	10
3	**BEAMS:** Definitions, types of beams, types of loading, types of supports. Determination of reactions for simply, Supported and overhanging beams. Relation between distributed load, Shear force and BendingMoment, Shear force and Bending moment in beams with diagrams	20	9
4	**FRICTION:** The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Analysis of systems involving dry frictions such as ladders spheres etc.,Belt Friction, Analysis of flat and v-belt.	25	10
5	**SIMPLE STRESSES & STRAINS:** Basics of stress and strain: 3-D state of stress (Concept only), Normal/axial stresses: Tensile & compressive Stresses: Shear and complementary shear Strains, Linear, shear, lateral, thermal	25	8

	and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Statics and Dynamics" Beer, F.P. and Johnston, E.R. Vector mechanics for engineers; Tata McGraw-Hill
2. "Engineering Mechanics: Statics and Dynamics" J.A Desai and B.B Mistry; Popular Prakashan
3. "Engineering Mechanics: Statics and Dynamics", R.C Hibbeler; Prentice Hall of India
4. "Engineering Mechanics: Statics and Dynamics "S Rajsekaran; Vikas Publication
5. "Engineering Mechanics" S.S. Bhavikatti and K. G. Rajashekarappa; Wiley 'Eastern Ltd
6. "Engineering Mechanics", J.L. Meriam, and L.G.Kraige; John Wiley and sons, New York Signals and Systems" by Simon Haykin and Barry Van Veen.

(4)

a. **Course Name:** Basic Electronics
b. **Course Code:** 303107151
c. **Prerequisite:** Knowledge of Physics and Mathematics up to12th science level
d. **Rationale:** The course provides introductory treatment of the field of Basic Electronics to the students of various branches of engineering.

e. **Course Learning Objective:**

CLOBJ1	Explain the fundamental concepts of electronic devices, such assemiconductor physics, diode and transistor operation, and semiconductor materials.
CLOBJ2	Analyze and describe the characteristics and behavior of variouselectronic devices, including diodes, transistors, and amplifiers.
CLOBJ3	Apply circuit analysis techniques to understand and design basicelectronic circuits involving devices like diodes and transistors.
CLOBJ4	Understand the principles of signal amplification and processing using electronic devices, including amplifier configurations and feedback systems.
CLOBJ5	Comprehend the principles of digital electronics, including logicgates, flip-flops, and digital circuit design.
CLOBJ6	Analyze and design circuits using operational amplifiers, includingapplications in amplification, filtering, and signal conditioning.

f. **Course Learning Outcomes:**

CLO 1	Understand the concept of intrinsic and extrinsic semiconductor.
CLO 2	Understand construction, characteristics of semiconductor devices like diode and bipolar junction transistor.
CLO 3	Understand and design circuits using components like diode, BJT,resistors, capacitors, inductors etc.
CLO 4	Identify and analyze different type biasing circuit.
CLO 5	Analyze and Design Transistor Amplifier Circuit.
CLO 6	Design DC Regulated Power Supply.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr No	Content	Weightage (%)	Teaching Hours
1	**Semiconductor and Diode Theory**: Conductors,Semiconductors, Silicon crystals, Types of flow, Doping a semiconductor, intrinsic semiconductors, extrinsic semiconductors, Energy level, energy hill, barrier potential and effect of temperature Ideal diodes, unbiased diode, forward bias, reverse bias, breakdown of diode. Calculation of bulk resistance, DC resistance of Diode and Load line, PIV, surge current. Reading a datasheet, Diode as Uncontrolled Switch.	10	5
2	**Circuits using PN Junction Diode:** Half-wave, Full- wave and Bridge rectifier, Clipper Clamper and Limiters, Choke and Capacitor input filter, Voltage Multiplier. Power supply and troubleshooting 10 5 3 Special Purpose Diodes: Construction of Zener diode, Characteristics of Zener diode, Application of Zener Diode as Voltage Regulator, load line Optoelectronic devices, Seven Segment Display, Schottky diode and its Application, Varactor Diode and its Application, Understanding Datasheets.	10	5
3	**Special Purpose Diodes:** Construction of Zener diode, Characteristics of Zener diode, Application of Zener Diode as Voltage Regulator,load line Optoelectronic devices, Seven Segment Display, Schottky diode and its Application, Varactor Diode and its Application, Understanding Datasheets.	10	4
4	**Bipolar Junction Transistor:** Construction, Configurations and Fundamentals: Construction of BJT, Working principle of BJT, Characteristics & specifications of BJT (PNP & NPN transistors), CE, CB, CC configurations, concept of gain & BW. Operation of BJT in cut-off, saturation & active regions (DC analysis). BJT as switch. Single stage BJT amplifier. Understanding Datasheet, Surface mounts transistor and trouble shooting.	20	8
5	**Transistor Biasing**: AC Model, Transistorized Amplifier, Low Frequency Analysis of Amplifier: Biased and unbiased BJT Voltage divider bias and analysis, VDB load line and Q point, two supply emitter biases. Base and Emitter biased amplifier, small signal operation, AC Beta, AC resistance of emitter diode. Voltage gain, loading effect, multistage amplifier. Two port devices and hybrid model, H parameter characteristics, three transistor	25	11

	configuration, transistor amplifier circuit using H parameter, comparison, linear analysis of transistor, physical model of CB transistor.		
6	**DC Regulated Power Supply**: Voltage Regulator- Basic series and shunt regulator, Transistor series Regulator, Regulator Design and performance. Improving Regulator performance- output voltage adjustment, high output current circuit, reregulation, constant current source. Fixed and adjustable positive and negative linear voltage regulator, IC linear fixed voltage regulator (78XX, 79XX, LM340 Series), Linear Adjustable Regulator (IC LM317, LM337, and IC 723 IC regulator), Switched mode power supply (SMPS).	**25**	**12**
	Total	**100**	**48**

i. Text Book and Reference Book:

1. Electronic Principles (TextBook) By A. P. Malvino.
2. Electronic Devices and Circuits by Jacob Millman and Halkias.
3. Electronic Devices and Circuits by Robert L. Boylestad andLouis Nashelesk.
4. Electronic Devices by Thomas L. Floyd.
5. Linear Electronic Circuits and Devices by James Cox.
6. Electronic Devices and Circuits by David A. Bell.

j. Experiment List:

Sr. No.	Experiment List
1	To Plot V-I characteristics Diodes. (a) PN junction diode Characteristic. (b) Zener Diode characteristics.
2	To Observe Rectifier Circuit (a) Half wave Rectifier without filter (b) Full wave rectifier without filter. (c) Half wave Rectifier with (L, C) filter (d) Full wave Rectifier with (L, C) filter and measure DC voltage regulation and ripple factor for various load currents in case of filtered output.
3	Designing of power supply using IC regulator circuit. (a) Designing of +5 Volt DC Power Supply using 7805. (b) Designing of -5 Volt DC Power Supply using 7905. (c) Designing of +12 Volt DC Power Supply using 7812. (d) Designing of -12 Volt DC Power Supply using 7912.
4	To Observe Response of Clipping and Clamping circuits using diodes. (a) Diode Positive Clipper without and with Biased clipper (b) Diode Negative Clipper without and with Biased clipper. (c) Biased Positive – Negative Clipper (Combinational Clipper) (d) Positive Clamper, Negative Clamper.
5	(a) To Plot and Study input- output characteristics of common Base (CB) configuration of Transistor
6	To study Voltage divider bias circuit: (a) To observe the effect of change in base current on Q- operating point (b) To set Q point for operation of transistor amplifier in linear region.
7	Study of Single Stage RC Couple Amplifier: Biasing, Voltage gain and observe frequency response of amplifier also find out its [1] cutoff frequency [2] bandwidth [3] mid band gain.
8	Optoelectronic devices: (a)To plot characteristics of LED (b)To plot Characteristic of Photo Diode (c) To observe isolated control of optocoupler.
9	To plot characteristics of Schottky and Varactor diode.
10	Designing of Linear Adjustable Regulator using IC LM317
11	Introduction to simulation tools Multisim and Designing of hybrid two port network using Multisim.
12	Simulation of Different Transistor Biasing Techniques in Multisim Software. (a) Self Bias (b) Voltage Divider Bias (c) Emitter Resistor Bias

(5)

a. **Course Name:** Engineering Graphics

b. **Course Code:** 303109101

c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level

d. **Rationale:** "Engineering Graphics" course Provide students with a comprehensive foundation in the fundamental principles and concepts that form the backbone of mechanical engineering for various Engineering disciplines.

e. **Course Learning Objective:**

CLOBJ 1	Identify and name common drafting tools and their uses.
CLOBJ 2	Interpret engineering drawings and symbols.
CLOBJ 3	Demonstrate the ability to create accurate engineering drawings using industry-standard software.
CLOBJ 4	Solve engineering design problems by applying geometric and spatial concepts.
CLOBJ 5	Generate accurate and professional engineering drawings independently.
CLOBJ 6	Design and create 3D models of engineering components using computer-aided design (CAD) tools.

f. **Course Learning Outcomes:**

CLO 1	Identify and recall common drafting tools and their uses.
CLO 2	Interpret and explain engineering drawings and symbols.
CLO 3	Demonstrate the application of industry-standard software to create accurate engineering drawings.
CLO 4	Solve engineering design problems by applying geometric and spatial concepts.
CLO 5	Generate accurate and professional engineering drawings independently.
CLO 6	Design and create 3D models of engineering components using computer-aided design (CAD) tools.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
2	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**INTRODUCTION TO ENGINEERING GRAPHICS** Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Introduction to Drawing Standards BIS-SP-46, Representative Fraction, Types of Scales (Plain and Diagonal Scale), Dimensioning Terms and Notations, Types of Arrowheads, Lines, Lettering, Numbering and Dimensioning	**5**	**1**
2	**ENGINEERING CURVES:** Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves - Conics, Spirals, Involutes and Cycloids with Tangents and Normal	**10**	**3**
3	**PRINCIPLES OF PROJECTIONS:** Types of Projections - Oblique, Perspective, Orthographic and Isometric Projections; Introduction to Principal Planes of Projections, Projections of Points located in all four Quadrants; Projections of lines inclined to one of the Reference Plane and inclined to two Reference Planes.	**10**	**3**
4	**PROJECTIONS OF PLANES:** Projections of various planes – Polygonal, Circular and Elliptical shape inclined to one of the Reference Plane and inclined to two Reference Planes; Concept of Auxiliary Plane of Projections.	**10**	**3**
5	**PROJECTIONS OF SOLIDS AND SECTIONS OF SOLIDS:** Classifications of basic Solids, Projections of Solids - Right Regular Prism, Pyramid, Cone, Cylinder, Tetrahedron and Cube inclined to one of the Reference Plane and inclined to two Reference Planes; Frustum of Prism, Pyramid and Cone inclined to one of the Reference Plane; Types of Cutting Planes - Auxiliary Inclined Plane, Auxiliary Vertical Plane, Horizontal Cutting Plane, Profile Cutting Plane; Sections of Solids resting on H.P/V.P and Inclined to only one of the Reference Planes; Sectional Views, True Shape of the Sections	**20**	**6**
6	**DEVELOPMENT OF SURFACES:** Methods of Development of Lateral Surfaces of Right Regular Solids, Parallel Line Development and Radial Line Development, Applications of Development of Surfaces.	**10**	**3**
7	**ORTHOGRAPHIC PROJECTIONS:** Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection method; Full Sectional	**15**	**5**

	Orthographic Views – Side and Front, Offset Cutting views		
8	**ISOMETRIC VIEW/DRAWING AND ISOMETRIC PROJECTIONS:** Conversion of Orthographic Views into Isometric Projection, View or Drawing; Isometric Scale.	**15**	**5**
9	**OVERVIEW OF COMPUTER AIDED DRAFTING TOOL:** Introduction to Computer Aided Drafting Software; Preparation of Orthographic Projections and Isometric Views Using Drafting Software	**5**	**1**
	Total	**100**	**30**

i. Text Book and Reference Book:

1. Engineering Drawing N.D. Bhatt & V.M. Panchal; Charotar Publishing House
2. ENGINEERING GRAPHICS P. J. Shah; S. Chand & Co., New Delhi Publications.
3. Graphic Science and Design French, T.E. Vierck, C.J & Foster; Tata McGraw Hill Publications.
4. Fundamentals of Engineering Drawing Luzadder; W. J & Duff Prentice Hall Publications.
5. Engineering Drawing and Graphics Venugopal k; New Age International Private Limited Publishers.

j. Experiment List:

Sr. NO.	Experiment List
1	Introduction to Engineering Graphics: Types of lines, Letterings, Drawing Symbols, Numberings, Dimensioning Terms and Notations, Title Block, Geometric Constructions etc.
2	Drawing Sheet on Engineering Curves.
3	Drawing Sheet on Projections of Points and Lines.
4	Drawing Sheet on Projections of Planes.
5	Drawing Sheet on Projections of Solids and Sections of Solids.
6	Drawing Sheet on Development of Surfaces.
7	Drawing Sheet on Orthographic Projections.
8	Drawing Sheet on Isometric Projection/View or Drawing.
9	Prepare 2D Drawings using AutoCAD.
10	Prepare Isometric Views using AutoCAD.

(6)

a. **Course Name:** Mathematics-II
b. **Course Code:** 303191151
c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12^{th} science level
d. **Rationale:** The mathematics II syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Define and identify ordinary differential equations of higher order. Classify ODEs based on homogeneity and linearity. Solve homogeneous linear ODEs of higher order with constant coefficients, and variable coefficients.
CLOBJ 2	Solve homogeneous linear ODEs of higher order with constant coefficients, variable coefficients
CLOBJ 3	Apply the Method of Undetermined Coefficients to solve nonhomogeneous ODEs. Utilize the Solution by Variation of Parameters for solving nonhomogeneous ODEs. Explore applications of ODEs in real-world scenarios.
CLOBJ 4	Understand power series solutions for ordinary points and regular singular points. Explore properties and applications of Legendre polynomials and Bessel functions.
CLOBJ 5	Define Laplace transform and its inverse. Understand the linearity property of Laplace transforms. Solve ordinary differential equations using Laplace transforms.
CLOBJ 6	Define Fourier Integral and its applications. Explore Fourier Cosine and Sine Integrals.

f. Course Learning Outcomes:

CLO 1	Demonstrate the ability to translate physical or engineering problems into mathematical equations and solve them.
CLO 2	Develop analytical and critical thinking skills through the process of solving complex mathematical problems.
CLO 3	Understand and interpret mathematical solutions in the context of the given problems.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms.
CLO 5	Present mathematical arguments and solutions in a logical and organized manner.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Higher order ordinary differential equations:** Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEs with Constant Coefficients, Euler–Cauchy equations, Nonhomogeneous ODEs, Method of Undetermined Coefficients, Solution by Variation of Parameters, Applications	8	5
2	**Power Series:** Power series solutions at ordinary point and regular singular point; Legendre polynomials, Bessel functions of the first kind and their property	15	9
3	**Laplace Transform:** Laplace Transform and inverse Laplace transform, Linearity, First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals, ODEs, UNIT Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Laplace transform of periodic functions, Short Impulses, Dirac's Delta Function, Convolution, Integral Equations, Differentiation and Integration of Transforms, Solution of ordinary differential equation by Laplace transform	25	15
4	**Fourier Integral:** Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral	17	10
5	**Vector Calculus:** Gradient of scalar field, Directional Derivative, Divergence and curl of Vector field, Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	10	6
6	**Multivariable Calculus (Integration):** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals (Cartesian)	25	15

	Total	**100**	**60**

i. Text Book and Reference Book:

1. "Calculus and Analytic Geometry (Textbook)", By G.B. Thomas and R.L. Finney, Addison Wesley
2. "Calculus with early transcendental functions", By James Stewart, Cengage Learning
3. "Higher Engineering Mathematics", By B. S. Grewal | Khanna Publications
4. "Elementary Linear Algebra (Textbook)", By Howard Anton, Chris Rorres | Willy India Edition | 9th Edition
5. "Advanced Engineering Mathematics (Textbook)", By Erwin Kreyszig | Willey India Education.

(7)

a. **Course Name:** Advanced Communication & Technical Writing
b. **Course Code:** 303193152
c. **Prerequisite:** Knowledge of English language studied till 12th standard.
d. **Rationale:** Communication confidence laced with knowledge of English grammar is essential for all engineers**.**
e. **Course Learning Objective:**

CLOBJ 1	Students will be able to demonstrate the ability to adapt writing style to different audiences and purposes.
CLOBJ 2	Students will create comprehensive technical documents such as reports, essay, review and project proposals.
CLOBJ 3	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content and confident delivery.
CLOBJ 4	Student will explore and apply technical communication through various mediums (video, web content, multimedia)
CLOBJ 5	Students will be able to incorporate advanced document design principles for clarity and readability.
CLOBJ 6	Students will be able to deliver different types of speeches.

f. **Course Learning Outcomes:**

CLO 1	Develop four basic communication skills.
CLO 2	Construct grammatically correct sentences.
CLO 3	Develop and deliver professional presentation skills.
CLO 4	Develop the skills of critical thinking.
CLO 5	Compare different types of written communication.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hrs.
1	**Developing Effective Listening Skills**: To help students understand the meaning and importance of good listening skills, learning the traits of being a good listener through activity and listening audio tracks.	**10**	**2**
2	**Error analysis**: To provide insights into the complicated processes of language development as well as a systematic way for identifying, describing and explaining errors. (Tenses, Voices, Reported speech)	**10**	**4**
3	**Delivering different types of speeches:** Students will understand and use the different patterns for structuring speeches Welcome / Introductory speech, Vote of Thanks speeches, Farwell speeches	**10**	**2**
4	**Professional Presentations**: Students will learn Combating stage fright, preparing power point presentation, Delivering PPT.	**10**	**5**
5	**Essay writing**: Students will overcome the common pitfalls in the task of essay writing by understanding Basics of Paragraph development and paragraph jumble Types of essays Characteristic features of essays Guiding Principles	**10**	**4**
6	**Reading Comprehension**: Employing Different Reading Skills, Activity, Practice	**10**	**2**
7	**Project Proposal**: To equip students with the various elements required to prepare a winning proposal.	**5**	**2**
8	**Misplaced Modifiers**: Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	**5**	**1**
9	**Movie Review**: A movie show followed by writing a review. To provide an exposure to students how to express their opinions about some film or documentary with unbiased and objective approach.	**10**	**2**

10	**Narrative Writing**: Narrative writing helps them explore different characters and settings. To help students clarify their thinking, and teach them to express that in writing in an organized way.	**5**	**2**
11	**Writing Reports**: Process of writing, Order of writing, Final draft & checklist for reports, Sample reports: Memorandum Letter report	**10**	**2**
12	**Critical Thinking**: Need, relevance and Significance of Critical Thinking, Logic in problem solving and decision making(activities) Moral Reasoning (Case Studies)	**5**	**2**
	Total	**100**	**30**

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press.
3. Practical English Usage MICHAEL SWAN.
4. A Remedial English Grammar for Foreign Student F.T. WOOD.
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition
6. Oxford Practice Grammar, John Eastwood; Oxford University Press.
7. Technical Communication: Principles And Practice Sangeetha Sharma, Meenakshi Raman; Oxford University Press.

Semester 3

(1)

a. **Course Name:** Control Theory

b. **Course Code:** 303111203

c. **Prerequisite:** Knowledge of Linear differential equations, Different equations and its solution and Laplace transform

d. **Rationale:** The course explores the fundamentals of control systems, understanding and predicting system behavior and design and analysis of closed loop control systems

e. **Course Learning Objective:**

CLOBJ1	Understand how analog and digital systems can be integrated toform complete electronic systems.
CLOBJ2	Explore real-world applications of analog and digital electronics in various fields, such as communication, control systems, and signal processing.
CLOBJ3	Develop problem-solving skills related to electronic circuit analysisand design.
CLOBJ4	Gain hands-on experience through laboratory exercises to reinforcetheoretical concepts and develop practical skills.
CLOBJ5	Understand the ethical considerations and responsibilities associated with designing and working with electronic systems.

f. **Course Learning Outcomes:**

CLO 1	Apply systems theory to complex real-world problems in order toobtain models that are expressed using differential equations, transfer functions, and state space equations.
CLO 2	Predict system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain
CLO 3	Analyze the behavior of closed loop systems using tools such asroot locus, Routh Hurwitz, Bode, Nyquist, and MATLAB.
CLO 4	Design controllers using classical PID methods, root locus methods,and frequency domain methods.
CLO 5	Design a safe and effective method of investigating a systemidentification problem in the laboratory.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction to Control Systems Introduction, Examples of Control Systems, Closed-Loop Control versus n-Loop Control, Digital ComputerControl.	5	3
2	Mathematical Modeling of Control Systems Introduction, Transfer Function and Impulse- Response Function, Automatic Control Systems, Transformation of Mathematical Models with MATLAB. Mathematical Modeling of Mechanical Systems, Mathematical Modeling of Electrical Systems, and Block diagram Model, Signal flow graph.	15	7
3	State Variable Models Concept of State Variable, State equation, State-Space Representations of Transfer-Function Systems, Transformation of System Models with MATLAB, Solving the Time- Invariant State Equation, Some Useful Results in Vector-Matrix Analysis Problem	15	6
4	Feedback Characteristics of Control System Feedback and non-feedback Systems, Reduction of parameters variations by use of feedback, Control over System dynamics by use of feedback, Control of the effects of disturbance signal by use of feedback, Linearizing effect of feedback, Regenerative feedback	5	3
5	Time response analysis Design Specifications and Performance Indices: Standard Test signal, Time response of first order systems, Time response of second order systems, Steady-state errors and errors constants, Effect of adding zero to a system, Design specifications of second order systems, Design consideration of higher order systems, Performance Indices	10	5
6	Concept of Stability and algebraic Criteria the Concept of Stability, Necessary condition of stability, Hurwitz stability criterion, Routh stability criterion, Relative stability analysis	5	3
7	Control Systems Analysis and Design by the Root- Locus Method Introduction, Root-Locus Plots, Plotting Root Loci with MATLAB, Root-Locus Plots of Positive Feedback Systems, Root-Locus	10	4

	Approach to Control-Systems Design		
8	Control Systems Analysis and Design by the Frequency-Response Method Introduction, Correlation between time and frequency response, Polar plots, Bode plots, All pass and minimum phase systems, Log magnitude versusPhase plots	**15**	**6**
9	Stability in frequency domain Introduction, Mathematical Preliminaries, Nyquist stability criterion, assessment of relative stability usingNyquist criterion	**10**	**3**
10	PID Controllers and Modified PID Controllers**:** Introduction, Ziegler–Nichols Rules for Tuning PID Controllers, Design of PID Controllers with Frequency- Response Approach, Modifications of PID Control Schemes, Two- Degrees-of-Freedom Control	**10**	**5**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Modern Control System by Richarc C. Drof and Robert H. Bishop | Person Int.
2. Modern Control Engineering by Katsuhiko Ogata | Prentice Hall of India
3. Control Systems Engineering by Nagrath and Gopal | New Age Publication
4. Automatic Control Systems by Benjamin C.Kuo | John Wiley & Sons
5. Feedback and Control Systems by Joseph J Distefano | TMH

j. Experiment List:

Sr. No.	Experiment List
1	Introduction to MATLAB Software
2	To obtain a transfer function from given poles and zeroes using MATLAB (A) To obtain a transfer function from given poles and zeroes using MATLAB. (B) To obtain zeros and poles from a given transfer function using MATLAB.
3	To Perform Block Diagram Reduction rules in MATLAB.
4	Generating standard test signals i.e. step, ramp, and unit impulseon a simulator.
5	To obtain the transfer function from the state model and statespace from transfer function.
6	Simulation of DC motor Working using state space model in MATLAB.
7	To obtain the time response of agiven second order system with its damping frequency.
8	Simulation of Transfer Functionof RC Circuit in MATLAB Software.
9	Plotting root loci of a given transfer function using a simulator.
10	Plotting phase magnitude plot ofa given transfer function with a simulator.
11	To control the closed loop system using PID controller

(2)

a. **Course Name:** Analog and Digital Electronics
b. **Course Code:** 303113201
c. **Prerequisite:** Knowledge of Basic Electronics
d. **Rationale:** The main objective of this subject is to inculcate basic concepts of Op-Amps & Digital circuits and system, which leads to design of complex digital system such as microprocessors. The course aims to familiarize students with combinational and sequential circuits using digital logic fundamentals.
e. **Course Learning Objective:**

CLOBJ1	Define and explain fundamental control system concepts, including open-loop and closed-loop systems, feedback, and control objectives.
CLOBJ2	Develop the ability to create mathematical models of dynamic systems using differential equations, transfer functions, and block diagrams.
CLOBJ3	Analyze the stability of linear time-invariant systems using stabilitycriteria such as the Routh-Hurwitz criterion and the Nyquist criterion.
CLOBJ4	Understand and analyze the transient and steady-state responses ofsystems to different inputs.
CLOBJ5	Apply frequency domain analysis techniques, such as Bode plots and Nyquist diagrams, to understand system behavior in the frequency domain.

f. Course Learning Outcomes:

CLO 1	Describe the functioning and selection of OP-AMP as per application.
CLO 2	Design and testing of OP-AMP based circuits.
CLO 3	Design and implement Combinational and Sequential logic circuits.
CLO 4	Describe the process of Analog to Digital conversion and Digital toAnalog conversion
CLO 5	Describe the functioning and selection of OP-AMP as perapplication.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
4	**-**	**2**	**5**	**20**	**20**	**20**	**60**	**-**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr No.	Content	Weightage (%)	Teaching Hours
1	**Differential, Multi-stage and Operational Amplifiers:** Differential amplifier; power amplifier; direct coupled multistage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product	15	12
2	Linear applications of Op-Amp: Idealized analysis of op-amp circuits. Inverting and non- inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	20	10
3	3 Nonlinear applications of Op-Amp: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular wave generators. Precision rectifier, peak detector	10	9
4	Combinational Digital Circuits: Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, Demultiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	20	10
5	Sequential Circuits and Systems: A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, JK-T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using.	20	9
6	A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.	15	10
	Total	100	60

i. Text Book and Reference Book:

1. OPAMP & Linear Integrated Circuits (TextBook) By Ramakant Gaiekwad | PHI
2. Fundamentals of Digital Electronics (TextBook) By A. Anandkumar | PHI Publication
3. Modern Digital Electronics By R. P. Jain | Tata McGraw-Hill Education
4. Design with Operational Amplifiers & Analog Integrated Circuits By Sergio Franco | McGraw Hill
5. Operational Amplifiers and Linear IC's By David A. Bell | Oxford University Press | 3rd edition.

j. Experiment List

Sr. No.	Experiment List
1	Study the different parameter ofop-amp.
2	Frequency response of invertingamplifier and non-inverting amplifier.
3	Study of op-amp as invertingamplifier and non-invertingamplifier.
4	OPAMP circuits –integrator, differentiator, and comparator.
5	Phase shift and Wein's Bridge oscillator with amplitudestabilization using OPAMPs.
6	Waveform generation – Square, triangular and saw tooth wave form generation using OPAMPs.
7	Application of op-amp as low pass filter, high pass filter and band-pass filter.
8	Verification of function of Half/Full adder circuits.
9	Verification of function of Binary to grey code conversion
10	Verification of function of Latch and flip-flop.
11	11. Verification of counter circuitlike binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12	Verification of Specification andPerformance indices of D/A and A/D converters.

(3)

a. **Course Name:** Electrical Machines
b. **Course Code:** 303113203
c. **Prerequisite:** Knowledge of Basic Electrical Engineering
d. **Rationale:** The Knowledge of different electrical machines is essential for student to understand applications of various types of electrical machines which are employed in industries, power stations, domestic and commercial appliances etc. The knowledge
e. **Course Learning Objective:**

CLOBJ 1	Understanding Singly excited systems - doubly excited systems - Force and Torque. Induction Motors
CLOBJ 2	Learn Principle of operation of Hybrid Stepper motor, Modes of Excitation – Static and Dynamic characteristics of stepper motor's introduction to Drive systems, Sizing of stepper motors
CLOBJ 3	Understand Principle of operation of AC/DC servomotor.
CLOBJ 4	Learn Types of Gearboxes, Linear Induction motor classification and Linear Synchronous motor (LSM)
CLOBJ 5	Understand Switched Reluctance Motors, Synchronous Reluctance Motors
CLOBJ 6	Understand Permanent Magnet Materials-Magnet Characteristics, Power Converter and their controllers

f. **Course Learning Outcomes:**

CLO 1	Explain the electromagnetic system for converting electrical energy into mechanical energy.
CLO 2	Explain the construction, working principle and applications of different electrical machines.
CLO 3	Understand the functions of different electrical machines and its extent of application in daily life.
CLO 4	Demonstrate speed control of different electrical motors and its role in automation.
CLO 5	Test different electrical machines and determine their performance parameters.
CLO 6	Identify the application of special purpose motors.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	3	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Principle of Electromechanical Energy Conversion** Magnetic circuits - Singly excited systems - doubly excited systems - Force and Torque. Induction Motors - Introduction	5	6
2	**Stepper Motors** Constructional features – Principle of operation – Types, Hybrid Stepper motor. Modes of Excitation – Static and Dynamic characteristics of stepper motors – introduction to Drive systems, Sizing of stepper motors -Applications	20	8
3	**AC / DC Servomotors** Servomotors: Types – Constructional features - Principle of operation – Feedback system - Sizing of servomotors – Applications	15	6
4	**Special Machines:** GEARED MOTORS: Design Principle – Types of Gearboxes – Selection of a Gear Unit – Operation Factor – Equivalent Power –Factors that affect operation factor – Geared Motor Applications LINEAR MOTORS: Linear Induction motor classification – Construction – Principle of operation – DC Linear motor (DCLM) types –DCLM Control applications – Linear Synchronous motor (LSM) – Types–Applications	20	08
5	**Reluctance Motors:** Switched Reluctance Motors: Constructional feature – principle of operation – torque production –Power converters and their controllers – methods of rotor position sensing sensor less operation-characteristics- closed loop control applications. Synchronous Reluctance Motors: Constructional feature -Axial and Radial flux motor-operating principles-voltage and torque equation – Phasor diagram --performance characteristics -	20	9

	applications		
6.	**Permanent Magnet Brushless DC Motors:** Permanent Magnet Materials-Magnet Characteristics-Permeance Coefficient-Permanent magnet Vs. Electromagnet. Magnetic circuit analysis – EMF and torque equations –Commutation – Power Converter and their controllers – Characteristics – Applications	**20**	**8**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Electrical Machine by Smarajit Ghosh.
2. Electrical Machine by Kothari D P and Nagrath I J.
3. Basic Electrical Engineering, By D. P. Kothari and I. J. Nagrath.
4. Electrical Machine by Bhattacharya S. K.
5. Rotating Machinery analysis By M. Adams.

j. List of Experiments:

Sr. No.	**Experiment Title**
1	To understand and perform an experiment on single phase induction motor.
2	Speed control of DC motor using field control method.
3	To understand and perform DC Servomotor with sweep operation using Ardunio.
4	To understand and perform different operation of stepper motor using Ardunio.
5	To understand working BLDC motor with Ardunio.
6	To simulate the operation of stepper motor driver using a two-phase hybrid stepper motor using MATLAB.
7	To simulate operation of switched reluctance motor using MATLAB.
8	Estimate the parameters of DC Servo motor using MATLAB simulation.
9	To study about linear induction motor.
10	Project using any special machines.

(4)

a. **Course Name:** Engineering Thermodynamics
b. **Course Code:** 303113205
c. **Prerequisite** Elements of Mechanical Engineering
d. **Rationale:** Knowledge of Engineering Thermodynamics is required to design any device involving the interchange between heat and work or the conversion of material to produce heat.
e. **Course Learning Objective:**

CLOBJ 1	Understand the fundamental principles of energy conservation and conversion in engineering systems.
CLOBJ 2	Analyse and apply the laws of thermodynamics to solve problems related to heat, work, and energy transfer.
CLOBJ 3	Evaluate the performance of various thermodynamic cycles and systems, such as power plants and refrigeration systems.
CLOBJ 4	Comprehend the properties of substances and their behaviour in different thermodynamic processes.
CLOBJ 5	Apply thermodynamic concepts to real-world engineering applications, including combustion processes and heat exchangers.
CLOBJ 6	Develop proficiency in using thermodynamic principles to optimize and design efficient energy systems.

f. **Course Learning Outcomes:**

CLO 1	Analyse and solve engineering problems by applying the principles of energy conservation and the first and second laws of thermodynamics.
CLO 2	Assess the performance of thermodynamic systems, such as heat engines, refrigeration cycles, and power plants, by applying relevant thermodynamic principles.
CLO 3	Demonstrate the ability to analyse and predict the thermodynamic properties of substances in various states and processes, including phase changes and chemical reactions.
CLO 4	Apply thermodynamic concepts to design and optimize engineering systems, demonstrating proficiency in selecting components and parameters to achieve desired performance and efficiency.

g. Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	-	3.00	20	20	-	60	-	100

L- Lectures**; T-** Tutorial**; P-** Practical**; C-** Credit**; MSE-** Mid-Semester Evaluation**, CE-** Continuous Evaluation**, ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**BASICS OF THERMODYNAMICS:** (a) Thermodynamic System, properties, process, cycle, thermodynamic equilibrium, Quasi-static Process, Zeroth Law of thermodynamics, Work and Heat transfer, flow work. (b) First Law of thermodynamics, internal energy, proof of internal energy as a point function, application of first law to non-flow process and steady flow process.	20	8
2	**SECOND LAW OF THERMODYNAMICS AND ENTROPY:** (a) Second law of thermodynamics: Limitations of the First Law, Thermal Reservoir, Heat Engine, Heat pump and Refrigerator, Parameters of performance, Second Law of Thermodynamics: Kelvin- Planck and Clausius Statements and their Equivalence, PMM of Second kind, reversibility and irreversibility, causes of irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale. (b) Entropy: Clausius theorem, Entropy - as a property, the inequality of Clausius, Entropy principle and its applications, Entropy change during different thermodynamic processes.	25	9
3	**PROPERTIES OF PURE SUBSTANCE:** Thermodynamic properties of pure substances in solid, liquid and vapour phases, Phase Transformations, dryness fraction, Triple point, critical state, p-v, p-T, T-s, h-s diagrams, P-V-T surfaces, Properties and processes in ideal vapour, use of steam tables and Mollier's diagram in determination of steam properties, energy interaction and entropy calculations for various thermodynamic processes.	15	9
4	**PROPERTIES OF GASES MIXTURE:** (a) Equation of state: Ideal gas equation of state, deviation of Real gas from ideal gas, van der waal's equation of state, correction for the intermolecular attractions, Evaluation of constants a and b, virial expansions, limitations of the van der Wall's equation, Reduced coordinates, compressibility factor, the law of corresponding states as per van der Waal 's principle. (b) Mixture of perfect gases: Mass Fraction, Mole fraction, Dalton's Law of additive pressure, Properties of mixture of ideal non-reactive gases – gas constant, molecular weight, specific heat,	15	9

	internal energy, enthalpy and entropy.		
5	**AVAILABILITY AND IRREVERSIBILITY:** (a) Availability and Irreversibility: Available energy, availability of a closed system, availability of steady flow system, Helmholtz function, Gibbs functions, Irreversibility for closed and open system, Second law efficiency. (b) Thermodynamic Relationships: Maxwell's equations, T-ds equations, difference in heat capacities, coefficient of Volume expansion and isothermal compressibility, adiabatic compressibility, ratio of specific heat, energy equations, Joule-Kelvin effect, Clausius – Clapeyran equation.	**25**	**10**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Thermodynamics - An Engineering Approach" by Cengel & Boles.
2. "Engineering Thermodynamics" by P. K. Nag.
3. "Fundamental of Engineering Thermodynamics" by R. Yadav.
4. "Thermal Science & Engineering" by D.S. Kumar.
5. "Engineering Thermodynamics" by Khurmi

(5)

a. **Course Name:** Product Realization
b. **Course Code:** 303113206
c. **Prerequisite:** Basic knowledge of Electronics and instrumentation required.
d. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism
e. **Course Learning Objective:**

CLOBJ 1	Grasp the entire product lifecycle, from ideation to end-of-life considerations.
CLOBJ 2	Develop design thinking skills and hands-on experience in prototyping.
CLOBJ 3	Understand design considerations for manufacturability and analyze cost implications.
CLOBJ 4	Explore supply chain management and optimize production planning for efficiency.
CLOBJ 5	Learn quality control techniques, ensuring regulatory compliance in product realization.

f. **Course Learning Outcomes:**

CLO 1	Develop cross disciplinary idea
CLO 2	Identify and rectify defects in parts and finding out exact problems
CLO 3	Conceive, design and prototype an innovative idea
CLO 4	To manage group projects, maintain timeliness and follow method-oriented approach to problem solving
CLO 5	To work in cross-functional groups and to apply the concepts learnt in theory to a practical problem

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**-**	**-**	**-**	**20**	**0**	**30**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

(6)

a. **Course Name:** Complex Variables and PDE
b. **Course Code:** 303191201
c. **Prerequisite:** Knowledge of Mathematics up to 12th science level
d. **Rationale**: The Mathematics I, Mathematics-II syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.
e. **Course Learning Objective:**

CLOBJ 1	Understand complex numbers in polar form, powers, and roots. Apply complex variable differentiation principles, including Cauchy-Riemann equations.
CLOBJ 2	Master contour integrals and apply the Cauchy-Goursat theorem. Utilize Cauchy Integral formula, Liouville's theorem, and Maximum-Modulus theorem.
CLOBJ 3	Express functions through power series, including Taylor and Maclaurin Series. Analyze zeros, singularities, and residues using the Cauchy Residue theorem.
CLOBJ 4	Solve first-order linear and nonlinear PDEs using Charpit's Method.
CLOBJ 5	Solve linear partial differential equations using complementary function and particular integral method.
CLOBJ 6	Apply separation of variables to solve problems, classify second-order linear equations, and model solutions for Heat, Wave, and Laplace equations.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate proficient problem-solving skills, translating real-world problems into mathematical formulations and applying appropriate techniques for solutions.
CLO 2	Develop integrated analytical and critical thinking skills by engaging with a wide range of mathematical structures, proofs, and problem-solving techniques presented throughout the entire syllabus.
CLO 3	Understand and interpret mathematical solutions within the context of specific problems, recognizing the practical applications of discrete mathematics in diverse fields covered in all units.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively, both in written and verbal forms, adapting communication styles to the diverse topics covered in each unit.
CLO 5	Present mathematical arguments and solutions in a unified, logical,

	and organized manner, emphasizing clarity, coherence, and precision across all units.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr No.	Topics	Weight Age (%)	Teaching Hours
1	UNIT 1 Complex Numbers: Polar Form of Complex Numbers, Powers and Roots Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.	**16**	**13**
2	UNIT 2 Complex Variable - Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof)	**18**	**9**
3	UNIT 3 Functions Given by Power Series: Taylor and Maclaurin Series, Laurent's series; Zeros of analytic functions, singularities, Residues, Cauchy Residue theorem (without proof), Residue Integration Method	**16**	**9**
4	UNIT 4 Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form	**16**	**10**

5	UNIT 5 First Order Partial Differential Equations: First order partial differential equations, solutions of first order linear and nonlinear PDEs, Charpit's Method	**16**	**10**
6	Unit 6: Second and Higher Order Partial Differential Equations: Solution to homogeneous and nonhomogeneous linear partial differential equations second and higher order by complementary function and particular integral method. Separation of variables method to simple problems in Cartesian coordinates, second-order linear equations and their classification, Initial and boundary conditions, Modelling and solution of the Heat, Wave and Laplace equations.	**18**	**9**
	Total	**100**	**60**

i. Text Book and Reference Books:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications.
2. E. Kreyszig, Advanced Engineering Mathematics.
3. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed.
4. D. G. Zill, P. D. Shanahan, A First Course in Complex Analysis with Applications.
5. P. O'Neill, Advanced Engineering Mathematics, 7th Edition, Cengage.
6. I. Sneddon, Elements of Partial Differential Equations.

(7)

a. Course Name: Professional Communication Skills

b. Course Code: 303193203

c. **Prerequisite:** Knowledge of English language in practical life.
d. **Rationale:** Knowledge and application of English, Aptitude and Management Skills are crucial for better employability as well as professionalism.

e. **Course Learning Objective:**

CLOBJ 1	Students will be able to demonstrate the ability to communicate clearly and persuasively in oral presentations.
CLOBJ 2	Students will practice active listening techniques to enhance understanding in professional interactions.
CLOBJ 3	Students will write professional emails, memos, and reports with clarity and conciseness.
CLOBJ 4	Students will understand and practice time management strategies effectively.
CLOBJ 5	Students will be able to demonstrate skills in resolving conflicts and negotiating effectively.
CLOBJ 6	Students will use digital communication tools and platforms effectively.

f. **Course Learning Outcomes:**

CLO 1	To develop advanced communication skills
CLO 2	To become more proficient in formal writing
CLO 3	To apply interpersonal communication skills to be more productive at the workplace
CLO 4	To identity, set and achieve the goals with the help of time management
CLO 5	To use with range of vocabulary to communicate effectively

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**2**	**0**	**2**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr.	**Content**	**Weight**	**Teaching**

		Age (%)	Hrs.
1	**Technical Writing: Email etiquette & Email writing Letter Writing (Types of Letters & Layouts)**: Trains students on detailed email and letter writing etiquette. Students will be able to write formal letters following certain stipulated formats. They will learn different types of letters for different official purposes.	**10**	**4**
2	**Interpersonal Communication at Workplace: Dynamics of communication**: To develop the confidence to handle a wide range of demanding situation more effectively at the workplace To enable the students to analyses their own interpersonal communication style.	**10**	**2**
3	**Debate: The three-minute debate planner**: To enable the students to generate effective critical thinking into primary issues in the given topic. Students will be able to resolve controversies and recognize strengths and weaknesses of arguments.	**10**	**4**
4	**Goal setting & Tracking**: To enable the students to define strategies or implementation steps to attain the identified goals and make progress every day.	**10**	**2**
5	**Time Management & Task Planning (Case –study)**: To enable the students to identify their own time wasters and adopt strategies to reduce them. To enable students to clarify and priorities their objective and goals by creating more planning time	**5**	**2**
6	**Reading Comprehension: Intermediate level**: To enable the students, develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	**10**	**2**
7	**Listening Skills: Small everyday conversation and Comprehension:** Provides practice on understanding accents and day to day conversations Listening to English conversations in different context.	**10**	**2**
8	**Information design and writing for print and online media: Blog Writing**: To enable students to design information that is targeted to specific audiences in specific situation to meet defined objectives. To create blogs and share their own knowledge and experience to the world.	**5**	**2**
9	**Advanced Vocabulary Building:** The students will expand their vocabulary so as to enhance their proficiency in reading and listening to academic texts, writing, and speaking. The students will attain vocabulary to comprehend academic and social reading and listening texts. The students will develop adequate speaking skills to communicate effectively.	**10**	**4**
10	**Picture Perception**: To prepare the students for a test for basic intelligence and IQ, generally done on the first day of SSB (Sashastra Seema Bal is one of India's Central Armed Police Forces)	**5**	**2**

11	**Appreciation, Apology and Acknowledgement letters**: To enable the students to maintain productive business relationship through different types of letters. To enable the students to express their feelings without speaking out loud.	**10**	**2**
12	**The Art of Negotiation**: To enable the students to reach an agreement for mutual benefits through negotiation. To enable the students to learn a process by which compromise or agreement is reached while avoiding argument and dispute.	**5**	**2**
	Total	**100**	**30**

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S And Lata P; New Delhi Oxford University Press.
3. Practical English Usage MICHAEL SWAN.
4. A Remedial English Grammar for Foreign Student F.T. WOOD.
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition.
6. Oxford Practice Grammar, John Eastwood; Oxford University Press.
7. Quantitative Aptitude for Competitive Examinations Dr. R.S. Aggarwal.

Semester 4

(1)

a. **Course Name:** Engineering Materials and Metallurgy
b. **Course Code:** 303113251
c. **Prerequisite:** Knowledge about properties of materials
d. **Rationale:** Basic principles of science are used to study the structure-properties relationships of various materials for their proper applications in this subject. Especially study of different types of ferrous and non-ferrous metals and alloys, in terms of their composition, structure, properties and applications; non-destructive testing are included in this course to understand the basic concept of selection and processing of metals and materials for their applications.

e. **Course Learning Objective:**

CLOBJ 1	Explore the relationship between the microstructure of materials and their mechanical, thermal, and electrical properties.
CLOBJ 2	Evaluate criteria for selecting materials based on mechanical, thermal, and corrosion properties for specific engineering applications.
CLOBJ 3	Gain knowledge of various manufacturing processes and heat treatments influencing the properties of metals, polymers, and ceramics.
CLOBJ 4	Develop skills to analyse material failures and understand the factors contributing to fatigue, fracture, and deformation in engineering components.
CLOBJ 5	Study the principles of alloy design and interpret phase diagrams to optimize material properties in metallic systems.
CLOBJ 6	Integrate knowledge of environmentally sustainable materials and processes into engineering design and manufacturing decisions.

f. **Course Learning Outcomes:**

CLO 1	Grasp the correlation between material microstructure and mechanical, thermal, and electrical properties.
CLO 2	Evaluate and justify material choices based on engineering requirements, considering factors like strength, durability, and corrosion resistance.
CLO 3	Apply manufacturing processes and heat treatments to control and enhance the properties of metals, polymers, and ceramics.
CLO 4	Analyse material failures and interpret phase diagrams to optimize material properties, demonstrating proficiency in alloy design and selection.

g. Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to Material Science Metallurgy:** Introduction to Material Science Metallurgy: Classification of Engineering Materials, Engineering requirements of materials, Criterion for selection of materials for engineering applications through Structure- Properties-Performance correlation ship.	6	5
2	**Crystal geometry and Crystal Imperfections:** Crystal geometry and Crystal Imperfections: Unit Cell, Crystal structure, Bravise lattice, atomic packing, coordination number, crystal structures of metallic elements, crystal directions and planes, Miller indices, Polymorphism or Allotropy. Crystal structure and correlated properties. diffusion processes; Crystallization: Mechanism of crystallization.	8	5
3	**Plastic Deformation:** Plastic Deformation: Deformation by slip, Mechanism of slip, slip in different lattice structures, Deformation by twinning, Strain hardening, Effect of strain hardening on properties, Recovery, Recrystallization and Grain Growth and their effect on properties of ductile metals.	6	3
4	**Solidification of metals and an alloy:** Solidification of metals and an alloy, Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures; Effects of Structure on Mechanical Properties, Methods to control the grain structure resulting from solidification, Solidification defects like porosity and shrinkage and remedies.	7	4
5	**Phase and Phase equilibrium:** Phase and Phase equilibrium: Unary and Binary equilibrium phase diagrams, Gibb's free energy for thermodynamic stability of phases, Gibb's Phase rule, solid solutions and compounds, Hume's Rothery rules, cooling curves, lever rule, Different reactions like eutectic,	9	3

	eutectoid, peritectic and peritectoid, non-equilibrium cooling.		
6	**Allotropy of Iron:** Allotropy of Iron, Iron-Iron-Carbide equilibrium system-phases and their properties of the Iron-Iron Carbide equilibrium diagram, different reactions of the Iron-Iron Carbide equilibrium system, Alloy groups (Wrought Irons, Steels and Cast Irons) of Iron-Iron Carbide equilibrium system and their characteristics in general, Equilibrium cooling of eutectoid, hypoeutectoid and hypereutectoid steels, their resultant microstructures and hence correlated properties and applications, IS and ISO Codification, Different specifications and designations of steels.	**15**	**5**
7	**Heat Treatment of Steels:** Heat Treatment of Steels: Time-Temperature-Transformation Diagram, Isothermal and continuous transformations; Austenitic grain size control/grain refinement, study of effects like temper-brittleness, overheating and burning of steels Study of Heat-Treatment processes with heat treatment cycles for plain C steels such as Different types of Annealing, Normalizing, hardening and tempering, full hardening and case hardening methods; Applications of above processes for the industrial practices.	**15**	**5**
8	**Alloy steels:** Alloy steels: Purpose of alloying; General effect of alloying elements on ferrite, carbide, transformation temperature, hardenability and tempering. Types: Chromium, Manganese, Molybdenum and Manganese steels. IS Codification. Tool Steels: Classification, properties, applications and IS and ISO Codification.	**6**	**2**
9	**Cast Iron:** Cast Iron: Iron-Iron Carbide and Iron-carbon diagrams, Transformations resulting into White Cast Iron, Grey Cast Iron, Malleable Cast Iron, S. G. Iron, Alloy Cast Iron. Their microstructures and correlated properties and applications. IS Codification.	**6**	**3**
10	**Non-ferrous alloys:** Non-ferrous alloys: alloys of copper, aluminium, magnesium titanium. Other alloys of lead, tin, zinc, nickel, manganese, white metals and bearing alloys.	**6**	**3**
11	**Powder Metallurgy:** Powder Metallurgy: Application and advantages, Production of powder, Compacting, Sintering, Equipment and process capability.	**6**	**3**
12	**Non-Destructive testing:** Non-Destructive testing of materials such as Radiography Testing, Dye Penetration Testing, Magnetic Particle Testing, Ultrasonic Testing. Eddy current testing with their principle of non-destructive testing, the test methods, relative merits, demerits and applications.	**10**	**4**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Callister's Material Science and Engineering 2" by R. Balasubramaniam.

2. “Introduction to Physical Metallurgy” by Sydney H. Avner.
3. “Material Science and Engineering Metallurgy” by Agrawal B. K.
4. “Mechanical Metallurgy” by George E. Dieter.

i. Experiment List:

Exp. No.	Name of the Experiment
1	Types of Engineering Materials, study about the different types of material and metals.
2	To study about Metallurgical Microscope, know about the metallurgical microscope and its detail analysis.
3	Specimen Preparation for Micro examination, to study about metallography technique.
4	Micro Examination of standard specimen, understand about different types of materials and its structure with respect to the application in industrial point of view.
5	Demonstration of Heat Treatment of steel, understand about the different stages of heat treatment and its importance in ferrous and non-ferrous metals application.
6	Study of Powder Metallurgy process, to get the knowledge about different stages of powder metallurgy steps and it application.
7	Demonstration of Ultrasonic Flow Detector, to understand the basic concept of ultrasonic testing method.
8	To study Magnetic Particle Testing, to get the details about magnetic particle testing method and its application to find out the defect in different ferrous metals.
9	To study Dye penetrating test, to get the basic idea about the steps of dye penetrating testing method in ferrous and nonferrous metals.
10	Demonstration of Jominy end quenching test, to understand the basic concept about hardenability and its importance to define the properties of materials.

(2)

a. **Course Name:** Theory of Machine for Mechatronics
b. **Course Code:** 303113253
c. **Prerequisite:** Fundamental Knowledge of mechanics is required.
d. **Rationale:** Theory of Machines is a fundamental course for Mechanical engineers to understand the working principals of any machine. This course is essential to understand the motion, transmission of the motion and the forces responsible for the motion.

e. **Course Learning Objective:**

CLOBJ 1	Analyse and apply principles of kinematics to describe the motion of machines and mechanisms in mechatronic systems.
CLOBJ 2	Study and evaluate the dynamic behaviour of mechanical systems, including forces, torques, and motion, using principles of dynamics.
CLOBJ 3	Examine and analyse the design and performance of machine elements such as gears, cams, and linkages in mechatronic applications.
CLOBJ 4	Gain proficiency in analysing vibrations in machines and mechatronic systems, including resonance and damping effects.
CLOBJ 5	Integrate control system concepts to analyse and design mechanisms for precise motion control and automation in mechatronic systems.
CLOBJ 6	Apply knowledge to design and optimize mechanical components and systems for specific mechatronic applications, considering performance and control requirements.

f. **Course Learning Outcomes:**

CLO 1	Apply kinematic principles to describe and analyse the motion of machines in mechatronic systems.
CLO 2	Evaluate the dynamic behaviour of mechanical systems, considering forces, torques, and motion dynamics.
CLO 3	Analyse and assess the design and performance of machine elements, such as gears and linkages, in mechatronic applications.
CLO 4	Design and optimize mechanical components and systems for specific mechatronic applications, integrating control system concepts for precise motion control.

g. Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	1	3	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Gyroscope:** Principle of gyroscope, Definition of axes, active and reactive couples; Roll, Yaw and Pitch motions; Gyroscopic effect in a rotor, two wheelers, Four wheelers, ship and aeroplane.	25	10
2	**Friction Devices: Clutches, Brakes and Dynamometers:** Classification of clutches, torque transmission capacity, considerations for uniform wear and uniform pressure theory, single plate and multi-plate clutch, centrifugal clutch, Energy equation and thermal considerations. Classification of brakes, Braking effect, Analysis of Brakes: Block Brake, Band Brake, Band and Block Brake, Internal expansion shoe brake; Braking analysis of four wheelers. Classification of Dynamometers, Analysis of Dynamometers: Prony brake, Rope brake, Hydraulic, Belt Transmission, Epicyclic-Train and Bevis-Gibson torsion.	35	12
3	**Flywheels:** Significance of flywheel, turning moment and crank effort diagrams for reciprocating machines, coefficient of fluctuation of speed and energy, limiting velocity of flywheel, Design of flywheels for engines and punching machines.	20	4
4	**Governors:** Necessity of governor, Classification of Governors, working principle of centrifugal governors, Concept of control force, Control force diagram, Stability of governor, Condition for stability, Concept of isochronism, Sensitivity of governor, Characteristics of governors, Hunting of governors.	20	4
	Total	100	30

i. Text Book and Reference Book:

1. "Theory of Machines" by Dr. Sadhu Singh.
2. "Theory of Machine" by S S Ratan.
3. "Theory of Machines" by Thomas Bevan.

4. “Theory of Machines and Mechanisms” by J.Uicker , Gordon R Penstock & J.E. Shigley.
5. “Theory of Machine” by V P Singh.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Determination of characteristics curves of sleeve position against speed for watt governors and also determination of characteristics curves of radius of rotation against controlling force.
2	Determination of characteristics curves of sleeve position against speed for porter governors and also determination of characteristics curves of radius of rotation against controlling force.
3	Determination of characteristics curves of sleeve position against speed for Proell governors and also determination of characteristics curves of radius of rotation against controlling force.
4	Determination of characteristics curves of sleeve position against speed for Hartnell governors and also determination of characteristics curves of radius of rotation against controlling force.
5	To study gyroscopic effect & determine gyroscopic couple on Motorized Gyroscope.
6	study function of various types of clutches and its applications.
7	To study principle of brake and function of various types of brakes.
8	To understand function and practical usefulness of dynamometer.
9	To study dynamic force analysis of slider, crank mechanism and its importance.
10	Design of flywheel and measurement of mass moment of inertia. a. Study of punching press, b. Design of flywheel.

(3)

a. **Course Name:** Basics of Signal & Systems
b. **Course Code:** 303113255
c. **Prerequisite:** Inclination to learn mathematics, basic knowledge of differential equations and difference equations, electrical circuits andnetworks
d. **Rationale:** The course will provide strong foundation on signals and systems which will be useful for creating foundation of communication and signal processing. The students will learn basic continuous time and discrete time signals and systems. Student will understand application of various transforms for analysis of signals and systems both continuous time and discrete time. Students will also explore to power and energy signals and spectrum.
e. **Course Learning Objective:**

CLOBJ 1	Define and differentiate between continuous-time and discrete-timesignals. Classify signals based on different criteria such as periodicity andenergy.
CLOBJ 2	Perform basic operations on signals, including addition, multiplication, and convolution. Understand the concept of signal scaling and time-shifting.
CLOBJ 3	Analyze signals and systems in the time domain. Understand the concept of Fourier series and Fourier transform forfrequency domain analysis.
CLOBJ 4	Study system properties such as linearity, time-invariance, causality,and stability. Apply these properties to analyze and characterize systems.
CLOBJ 5	Introduce the Laplace transform for analyzing signals and systems inthe complex frequency domain. Solve differential equations using Laplace transforms.
CLOBJ 6	Introduce the Z-transform for discrete-time signal and system analysis. Apply Z-transform techniques to analyze and design discrete-time systems

f. **Course Learning Outcomes:**

CLO1	Understand the characteristics of different types of signals.
CLO2	Understand the behavior of different types of systems.
CLO3	Analyze the system in various domains using different transformation methods, like, Fourier transform, Z- transform,etc.,
CLO4	Check the stability of the system

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction to signals and systems Introduction to signals, classification of signals, basic continuous- time and discrete- time signals, step and impulse functions, transformation of independent variable.	**20**	**8**
2	Systems Introduction to systems, properties of systems, classification of systems, mathematical model for systems, normal form of system equations, initial conditions.	**15**	**7**
3	Time-Domain Representations of Linear Time- Invariant System Introduction, Convolution, Impulse response representation for LTI systems, Properties of the impulse response representation for LTI systems, Block diagram representation, State-variable descriptions for LTI systems.	**25**	**11**
4	Z-transform, convergence of Z- transform, properties of Z-transform, inversion of Z-transform, evaluation of system frequency response, applications of Z-transform	**25**	**11**
5	Fourier series and transform Fourier series representation, power spectrum, Fourier Transform, system function, energy spectrum. Calculation of simple transforms, Discrete Fourier Transform (DFT), properties of Discrete Fourier Transform.	**15**	**8**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Introduction to Physical Metallurgy by Sydney H. Avner.
2. Callister's Material Science and Engineering, 2 By R. Balasubramaniam.
3. Materials Science and Engineering: By V. Raghavan.
4. Mechanical Metallurgy by George E. Dieter.
5. Practical Non-Destructive Testing, By Baldev Raj, T. Jayakumar and M. Thavasimuthu.

j. Experiment List:

Exp. No.	Name of the Experiment
1	To familiarize with MATLAB software, general Functions and Signal Processing Toolbox Functions.
2	To generate the following waveforms using MATLAB in continuous and discrete time 1) Sine 2) Cosine 3) Square 4) Sawtooth Wave.
3	To generate the following waveforms using MATLAB in continuous and discrete time 1) Unit Step 2) Unit Impulse 3) Unit Ramp 4) Exponential
4	Implementation of Nyquist Criteria using Sampling Theorem.
5	To Perform Linear Convolution of Two Discrete Time Sequences
6	Write A MATLAB program to locate poles and zeros from the transfer function.
7	Computation of partial fraction expansion of a given Z-transform.
8	To compute FFT and IFFT from user-defined input sequences
9	To plot unit step and impulse response for the given system by using function filter.
10	Introduction to Simulink.
11	Modeling of physical systems using Simulink
12	Generate unit step and decaying exponential function and perform convolution between the same.
13	To perform circular convolution of two given sequences.
14	To write a MATLAB program to plot magnitude response and phase response of digital butter worth low pass filter.
15	Part–A: To write a MATLAB program to verify the time shifting properties of DFT. Part–B: To write a MATLAB program to verify the linearity properties of DFT.

(4)

a. **Course Name:** Microcontrollers and Interfacing
b. **Course Code:** 303113257
c. **Prerequisite:** Basic knowledge of Digital Electronics.
d. **Rationale:** The purpose of this course is to teach students the fundamentals of microcontroller because microcontrollers are being excessively used in the field of automation in every field. The students studying the subject are supposed to learn the architecture and programming of typical microcontroller. Students will be taught the basic use of an assembly as well as embedded C programming environment to control peripheral devices. Students will also understand the interfacing of various peripheral elements with microcontroller to design an automated system.

e. Course Learning Objective:

CLOBJ 1	Understand the architecture and functioning of microcontrollers, including their memory, I/O ports, and instruction set.
CLOBJ 2	Acquire proficiency in programming microcontrollers using assembly language and high-level languages for embedded systems.
CLOBJ 3	Design and implement interfaces between microcontrollers and external devices, sensors, and actuators for practical applications.
CLOBJ 4	Apply microcontroller programming skills to develop real-time control systems for monitoring and regulating external processes.
CLOBJ 5	Investigate and apply communication protocols, such as UART and SPI, for data exchange between microcontrollers and external devices.
CLOBJ 6	Develop skills to troubleshoot and debug microcontroller-based systems, ensuring efficient and reliable operation in various applications.

f. Course Learning Outcomes:

CLO 1	Demonstrate a comprehensive understanding of microcontroller architecture and proficiently program in assembly language and high-level languages for embedded systems.
CLO 2	Design and implement effective interfaces between microcontrollers and external devices, sensors, and actuators for diverse applications.
CLO 3	Apply microcontroller programming skills to develop real-time control systems, showcasing the ability to monitor and regulate external processes.
CLO 4	Investigate, select, and apply communication protocols, such as UART and SPI, for efficient data exchange between microcontrollers and external devices.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to 8051 Microcontroller:** Microprocessor Vs. Microcontroller, 8051 Architecture Registers, Microcontrollers and embedded processors, Overview of 8051 family Architecture of 8051, 8051 Memory organization, Registers, Special Function Registers (SFRs), Program Status Word (PSW), Program counter & ROM space in 8051.	10	5
2	**8051 Instruction Set:** Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.	15	7
3	**8051 Stack, I/O Port Interfacing and Programming:** 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.	20	7
4	**8051 Timers and Serial Port:** 8051 Timers and Counters-Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication Basics of Serial Data Communication, RS232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.	15	10
5	**8051 Interrupts and Interfacing Applications:** 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing with 8051- LCD system – 4x4 keyboard – ADC and DAC – Stepper motor – DC motor – Water Level Indicator – Temperature control	40	16

	and their 8051 Assembly language interfacing programming.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "8051 Microcontroller & Embedded system using assembly & C" by Muhmmad Mazidi.
2. "8051 microcontroller & Embedded system using assembly & C" by K J Ayala.
3. "Programming and Customizing the 8051 Microcontroller" by Myke Predko."The 8051 Microcontrollers, Architecture and programming and Applications" by K.Uma Rao, Andhe Pallavi.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Programming 8051 Micro controller using ASM and C, and implementation in flash 8051 microcontroller.
2	Programming with Arithmetic logic instructions [Assembly]
3	Program using constructs (Sorting an array) [Assembly]
4	Programming using Ports [Assembly and C].
5	Delay generation using Timer [Assembly and C]
6	Programming Interrupts [Assembly and C].
7	Implementation of standard UART communication (using hyper terminal) [Assembly and C].
8	Interfacing LCD Display. [Assembly and C].
9	Interfacing with Keypad [Assembly and C].
10	Programming ADC/DAC [Assembly and C].
11	Interfacing with stepper motor. [Assembly and C].
12	Pulse Width Modulation. [Assembly and C] Programming ARM Micro controller using ASM and C using simulator
13	Programming with Arithmetic logic instructions [Assembly]

(5)

a. **Course Name:** Probability Statistics and Numerical Method
b. **Course Code:** 303191251
c. **Prerequisite:** Knowledge of Mathematics up to 12th science level
d. **Rationale**: The Mathematics I, Mathematics-II syllabus integrates fundamental calculus concepts, advanced mathematical techniques, and vector calculus, preparing students for engineering challenges with optimized problem-solving skills.

e. **Course Learning Objective:**

CLOBJ 1	Understand fundamental concepts of probability, probability spaces, conditional probability, and Bayes' Rule for making informed statistical decisions.
CLOBJ 2	Analyse discrete and continuous random variables, compute expectations and variances, and explore key distributions such as Binomial, Poisson, and Normal.
CLOBJ 3	Develop skills in hypothesis testing, including large sample tests for proportions, means, standard deviations, and chi-square tests for goodness of fit and independence.
CLOBJ 4	Demonstrate proficiency in numerical methods for solving linear equations, finding roots of algebraic and transcendental equations using techniques like Gauss-Jacobi, Gauss-Seidel, Bisection, Newton-Raphson, and Regula-Falsi.
CLOBJ 5	Master the concepts of finite differences, interpolation using Newton's Forward and Backward Difference Formula, Newton's Divided, and Lagrange's Formula for Unequal Intervals.
CLOBJ 6	Gain expertise in numerical integration techniques such as the Trapezoidal rule, Simpson's 1/3rd and 3/8th Rules, Gaussian Quadrature, and solve ordinary differential equations using methods like Taylor's series, Euler, Modified Euler, and Runge-Kutta of the fourth order for first and second-order equations.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate proficient problem-solving skills, translating real-world problems into mathematical formulations and applying appropriate techniques for solutions.
CLO 2	Develop integrated analytical and critical thinking skills by engaging with a wide range of mathematical structures, proofs, and problem-solving techniques presented throughout the entire syllabus.
CLO 3	Understand and interpret mathematical solutions within the context of specific problems, recognizing the practical applications of discrete mathematics in diverse fields covered in all units.
CLO 4	Communicate mathematical concepts and solutions clearly and effectively,

	both in written and verbal forms, adapting communication styles to the diverse topics covered in each unit.
CLO 5	Present mathematical arguments and solutions in a unified, logical, and organized manner, emphasizing clarity, coherence, and precision across all units.
CLO 6	Lay a solid foundation for more advanced courses in mathematics and related disciplines.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr No	Topics	Weightage (%)	Teaching Hours
1	UNIT 1 Correlation, Regression and Curve Fitting: Correlation and Regression – Rank correlation, Curve Fitting by The Method of Least Squares- Fitting of Straight Lines, Second Degree Parabolas and More General Curves	**18**	**9**
2	UNIT 2 Probability and Probability Distributions: Probability Spaces, Conditional Probability, Bayes' Rule, Discrete and Continuous Random Variables, Independent Random Variables, Expectation and Variance of Discrete and Continuous Random Variables, Distribution and Their Properties: Binomial Distribution, Poisson Distribution, Normal Distribution	**23**	**10**
3	UNIT 3 Testing of Hypothesis: Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. Test for single mean, difference of means, Test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.	**22**	**15**
4	UNIT 4 Solution of a System of Linear Equations, Roots of Algebraic and Transcendental Equations: Gauss-Jacobi and Gauss-Seidel Methods, Solution of Polynomial and Transcendental Equations Bisection Method, Newton-Raphson Method and Regula-Falsi Method	**17**	**10**
5	UNIT 5 Finite Differences and Interpolation:	**10**	**8**

	Finite Differences, Relation between Operators, Interpolation using Newton's Forward and Backward Difference Formula. Newton's Divided and Lagrange's Formula for Unequal Intervals.		
6	UNIT 6 Numerical Integration: Trapezoidal rule, Simpson's 1/3rd and 3/8th Rules, Gaussian Quadrature Formulae.	**10**	**8**
	Total	**100**	**60**

i. Text Book and Reference Book:

1. B. S. Grewal, "Numerical Methods in Engineering & Science with Programs in C and C++", Khanna Publishers.
2. C.E. Froberg, "Introduction to Numerical Analysis", Addison-Wesley.
3. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003 (Reprint).
4. S.C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons.
5. Norman L. Biggs, Discrete Mathematics, 2nd Edition, Oxford University Press.

(6)

a. **Course Name** Professional Grooming & Personality Development
b. **Course Code:** 303193252
c. **Prerequisite:** Knowledge of communication theories and basic management skills are essential.
d. **Rationale:** Acquiring soft skills, life skills and aptitude skills are crucial for organisational communication as well as employability respectively.
e. **Course Learning Objective:**

CLOBJ 1	Students will develop clear and articulate verbal communication skills.
CLOBJ 2	Students will enhance non-verbal communication, including body language and facial expressions.
CLOBJ 3	Students will be able to understand the importance of personal grooming and hygiene in a professional setting.
CLOBJ 4	Students will be able to understand and apply proper business etiquette in various professional settings.
CLOBJ 5	Students will be able to develop emotional intelligence to understand and manage one's own emotions and those of others.
CLOBJ 6	Students will be able to cultivate leadership qualities and skills to inspire and influence others positively.
CLOBJ 7	Students will be able to understand and practice professional etiquette in various business settings.

f. **Course Learning Outcomes:**

CLO 1	Identity and develop soft skills required for personal and professional growth.
CLO 2	Develop professional etiquette & desired behaviour at the workplace.
CLO 3	Speak and participate effectively in oral organizational communication.
CLO 4	Improve comprehensive skills for reading.
CLO 5	Know how to be assertive in professional environment.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	1	0	1	-	100	-	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weight Age (%)	Teaching Hrs.
1	**Self-Development and Assessment**: Various self-assessments for personal and professional development skills that are relevant to career development: Change, Grow, Persist, Prioritize, Read, Learn, Listen, Record, Remember, Guess, Think, Communicate, Relate, and Dream	**25**	**4**
2	**Corporate Etiquette**: Tips and guide to develop personality and gain various etiquettes manners, case studies and activities. Telephone etiquette, Etiquette for foreign business trips, Etiquette for small talks, respecting privacy, learning to say 'No'.	**25**	**4**
3	**Public Speaking**: It's process of communicating information to an audience and is helpful in career advancement. Effective Public speaking skills includes: Choosing appropriate pattern, selecting appropriate method, Art of persuasion, Making speeches effective Delivering different types of speeches.	**20**	**4**
4	**Reading Skills Activity & Reading Comprehension**: Aims to improve students' Comprehensive Skills in English Language by getting them involved in reading activity and providing practice for reading comprehension.	**15**	**2**
5	**Listening Skills- Inquiry Based Listening Questions**: Aims to improve students' listening skills in English Language providing them practice of various types of inquiry based listening tracks. Students will listen and will be able to find out details from the conversations.	**15**	**1**
	Total	**100**	**15**

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills Kumar S and Lata P; New Delhi Oxford University Press.
3. Practical English Usage MICHAEL SWAN.
4. A Remedial English Grammar for Foreign Student F.T. WOOD.
5. On Writing Well William Zinsser; Harper Paperbacks,2006; 30th anniversary edition.
6. Oxford Practice Grammar, John Eastwood; Oxford University Press.

Semester 5

(1)

a. **Course Name:** Sensors and Transducers
b. **Course Code:** 303113301
c. **Prerequisite:** Basic knowledge of laws of Physics.
d. **Rationale:** Knowledge of Sensors & Transducers is essential for designing real time applications.
e. **Course Learning Objective:**

CLOBJ1	Understand the fundamental principles governing sensors and transducers, including their types, working mechanisms, and key characteristics.
CLOBJ2	Apply theoretical knowledge to analyze and design sensor systems, considering factors such as sensitivity, accuracy, and response time.
CLOBJ3	Evaluate the selection and integration of sensors and transducers for specific applications, taking into account environmental conditions and performance requirements.
CLOBJ4	Demonstrate proficiency in interfacing sensors with electronic circuits, signal conditioning, and data acquisition systems.
CLOBJ5	Develop problem-solving skills to troubleshoot and optimize sensor and transducer-based systems, addressing issues related to calibration, reliability, and maintenance.

f. **Course Learning Outcomes:**

CLO 1	Understand working of different sensors.
CLO 2	Understand applications of sensors.
CLO 3	Understand working of different measuring devices.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching hours
1	**MEASURING INSTRUMENTS** Measurement-definition-methods of measurement-Significance- Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration -Errors in Measurements-Systematic and Random error. Measuring instruments- Factors in selecting the measuring instruments. Force measuring devices, Torque measuring devices, pressure measuring devices, Construction, working and applications. Speed measurement, Displacement measurement, Flow measurement-, Construction, working and applications	**10**	**8**
2	**SENSORS** Definition, Need for Sensors, Examples, Classifications, Detectable Phenomenon, Physical Principles, Sensor Descriptions, Concept-Characteristics, selection factors for Sensors. Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer, GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).	**20**	**8**
3	**FORCE, MAGNETIC AND HEADING SENSORS** Strain Gauge, Load Cell, Magnetic Sensors -types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.	**25**	**10**
4	**TRANSDUCERS** Concept-Characteristics, Transducers selection factors, classifications of Transducer, actuating mechanisms. Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers, Principle, operation of resistor, inductor and capacitor transducers, Strain gauge and its principle of operation, Gauge factor, Thermistors, Thermocouples, Synchros, Piezo electric transducers, Photo diodes. Voltage and current generating Analog transducers Types- Piezoelectric transducer	**25**	**10**
5	**SIGNAL CONDITIONING AND DAQ SYSTEMS** amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging – applications – Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.	**20**	**9**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "A course in electrical & Electronic measurement and instrumentation" by A.K.Sawhney.
2. "Industrial Instrumentation & Control" by S. K. Singh.
3. "Measurement and Instrumentation Principles" by Alan S Morris

j. Experiment List:

Sr. No.	Experiment List
1	To study and understand working of microphone
2	To study and understand electric motors
3	To study the principle and working of ph. measurement
4	To study and perform strain gauge
5	To study and perform working of platinum RTD
6	To study and observe the measurement of pressure using pressure transducers.
7	Study and perform input-output characteristics of LVDT
8	To study and understand working of battery and fuel cell
9	To study and understand working of loudspeaker.
10	To study and perform ohmmeter, voltmeter, watt-hour mete
11	To study and perform galvanometer
12	To study the operation of a non-contact type speed measuring transducer using photo reflective pick up.
13.	To study and perform Hall Effect sensor
14.	To study and understand oxygen sensor
15.	To study and understand air flow sensor

(2)

a. **Course Name:** Manufacturing Process

b. **Course Code:** 303113303

c. **Prerequisite:** Basic knowledge of mechanical workshop subject.

d. **Rationale:** Subject is useful to understand the basics of conventional metal removing processes used on industrial shop floor. Aspects of conventional machining are covered in this course to help students understand the concepts of cutting mechanics.

e. **Course Learning Objective:**

CLOBJ1	Understand the fundamental principles of manufacturing processes, including material selection, machining, and forming techniques, to analyze and optimize production methods.
CLOBJ2	Apply knowledge of manufacturing technologies to design and implement efficient and cost-effective production processes, integrating computer-aided design and manufacturing tools.
CLOBJ3	Evaluate and troubleshoot manufacturing challenges by employing problem-solving skills, quality control methods, and process improvement strategies.
CLOBJ4	Demonstrate proficiency in utilizing various manufacturing equipment and tools, ensuring safety protocols, and applying best practices for efficient and precise production.
CLOBJ5	Develop a comprehensive understanding of sustainable manufacturing practices, incorporating environmental considerations, waste reduction, and resource efficiency into the production workflow.

f. **Course Learning Outcomes:**

CLO 1	Understand the basic concept of machining operation. & become familiar with manufacturing and production fundamentals.
CLO 2	Analyse any conventional machining processes and generate the sequence of machining operation to produce the end product.
CLO 3	Decide and graphically represent the sequence of machining operations, which are most appropriate from the functionality point of view.
CLO 4	Judge the limitations and scope of machines to perform variety of operations
CLO 5	Learn the concepts of machining manufacture, which are important to minimize the production cost and production time along with the significant improvement in the quality of end product.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction of Machining Technology & Principles Mechanism of Metal Cutting: Deformation of Metal During Machining, Nomenclature of Lathe, Milling Tools, Mechanics of Chip Formation, Built-Up Edges, Mechanics of Orthogonal and Oblique Cutting, Merchant Cutting Force Circle and Shear Angle Relationship in Orthogonal Cutting, Factors Affecting Tool Forces. Cutting Speed, Feed and Depth of Cut, Surface Finish. Temperature Distribution, Tool Chip Interface.	10	5
2	Metal Cutting Lathe Types of Lathes, construction, Operations carried on engine lathe, attachment extending the processing capacities of engine lathes, Capstan and Turret lathes, Taper turning on lathe, Thread cutting on lathe using gear train and chasing dial, Alignment tests of lathes	25	9
3	Milling Machine Types of milling machines, general purpose milling machines, different types of milling operations, milling cutters, attachments extending the processing capabilities of general-purpose milling machines, Indexing, Helical milling operation and its set up, Alignment tests of milling machine.	15	6
4	Grinding Machines and Abrasives Classification of grinding machines, cylindrical grinders, internal grinders, Surface grinders, tool and cutter grinders, centreless grinders, Types of grinding wheels, wheel characteristics and wheel selection.	15	6
5	Planers, Shapers and Slotters Planers, Shapers and Slotters: Construction of Machine, different Mechanisms available & thrier operating, Operations carried out on machine be. Sawing and Broaching Machines: Metal sawing classification: reciprocating sawing machines, circular sawing machines, band sawing machines, Types of broaching machines, advantage and limitations of broaching	10	7
6	Fundamentals of automatic machine tools Principles of operation - features - Classification -Developments, Machining Centres, Interpolations - Open loop and closed loop control systems - CNC	25	12

	controllers -Direct Numerical Control, Adaptive Control - Machine structures, slide ways, linear bearings, Recirculating ball screws, Drives - spindle and feed drives Feedback devices.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Manufacturing Technology by P.N.Rao.
2. Production Technology by R.K. Jain.
3. Manufacturing Science by A Ghosh and A K Mallik.
4. Metal Cutting Principles by M C Shaw.
5. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar.

j. Experiment List:

Sr No.	Experiment List
1	To get an overview of the various machine tools.
2	Introduction to Lathe Machine & perform various lathe operation on a given work-piece.
3	Demonstration on Drilling Machine.
4	To understand milling machines and demonstration on milling machine.
5	To understand the principle, construction & operations of planer machine and performance on shaper machine
6	To understand construction & working of grinding machines.
7	To Study of various types of cutting tools: materials & tool geometry & manufacturing of single point cutting tool.
8	To Measure cutting forces in turning operation by using lathe and drilling tool dynamometer under various cutting conditions
9	Problems on Merchant Circle Diagram
10	To study about various components used in automate the machine tools.

(3)

a. **Course Name:** Kinematics and Dynamics of Machines
b. **Course Code:** 303113305
c. **Prerequisite:** Basic knowledge of Mechanical Engineering
d. **Rationale:** Kinematics and Dynamics is fundamental course for mechatronics engineers to understand various mechanisms. This course is essential for kinematic and dynamic analysis of any mechanism and machine.

e. **Course Learning Objective:**

CLOBJ1	Master the principles of kinematics and dynamics to analyze and predict the motion of machines, including linkages, gears, and cam-follower systems, using mathematical models and graphical methods.
CLOBJ2	Apply computational tools and software to simulate and optimize the performance of machines, considering factors such as speed, acceleration, and force within the context of dynamic systems.
CLOBJ3	Demonstrate the ability to design and analyze machine components for optimal efficiency and reliability, taking into account factors like vibrations, balancing, and power transmission.
CLOBJ4	Evaluate the impact of various forces and moments on machine elements, and design mechanisms that ensure stability, minimize wear, and maximize energy transfer.
CLOBJ5	Integrate theoretical knowledge with practical applications, fostering the skills to troubleshoot and solve real-world engineering problems related to the kinematics and dynamics of machines.

f. **Course Learning Outcomes:**

CLO 1	Deduce the force motion relationship in components subjected to external forces and analysis of standard mechanisms.
CLO 2	Quantify unbalanced forces in rotary and reciprocating balancing systems.
CLO 3	Understand effects of Mechanical vibratory systems.
CLO 4	Understand arbitrary linear single D.O.F. system and multi D.O.F. systems.
CLO 5	Conduct the experiments to understand various concepts of dynamics.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, four bar chain and Slider Crank Mechanisms and their Inversions, Degrees of Freedom, Mobility and range of movement - Kutzbach and Grublers criterion, Number Synthesis, Grashofs criterion	10	5
2	Velocity and Acceleration Analysis Velocity and Acceleration Diagrams, Instantaneous Centre of Velocity, Rubbing Velocity, Velocity and Acceleration Images, Coriolis component of acceleration. Special Mechanisms: Straight line mechanism, Indicator diagrams, Hooke's Joint, Steering Mechanisms	25	10
3	Cams Types of Cams and Followers, Cam Terminology, Derivatives of Follower Motion, Cam Profile Layout	15	7
4	Balancing Need for balancing, Static balance, balancing of rotating masses in same and different planes, Numerical, Dynamic balancing, balancing of reciprocating masses, Numerical.	20	8
5	Mechanical Vibrations Introduction, Degree of freedom, Types of vibrations, uses effects and remedy; free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations; under damped, critically damped and over damped systems, response curves for single degree of freedom system. Numerical. Forced vibrations with and without damping in single degree of freedom, base excitations, Numerical: Vibration Isolation and transmissibility; Force transmissibility, Motion transmissibility. Forced vibration with rotating and reciprocating Unbalance. Materials used in vibration isolation, Numerical Longitudinal and Transverse Vibrations, whirling of shaft with a single disc with and without damping, Dunkerley's method for simply supported beams.	30	15

	Torsional vibrations, torsional equivalent system, stepped shafts and tapered shafts, two rotors, Numerical.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Vibration Fundamentals & Practice" by S.S Rao.
2. "Theory of Machine" By S.S Ratan.
3. "Kinematics and Dynamics of Machinery "by Wilson.
4. "Kinematics and Dynamics of Machinery" by R L Norton.
5. "Kinematics and Dynamics of Machines" by G.H. Martin.

j. Experiment List:

Sr. No.	Experiment List
1	To study about concept of Kinematics and Dynamics.
2	Understand and verify concept of Velocity Analysis and prepare sheet for the same.
3	Understand and verify concept of Acceleration Analysis and prepare sheet for the same
4	Study of cam and follower.
5	Study of Special Mechanism.
6	Understand and verify the fundamental laws of static & dynamic balancing.
7	Study and confirm relation between the period of oscillation and length of pendulum for simple and compound pendulums.
8	Study longitudinal vibrations of spring mass system
9	To study the undamped free vibration of equivalent spring mass system.
10	To determine the time period and frequency of torsional vibrations of a single rotor system.
11	To determine the time period and frequency of torsional vibrations of two rotors system.
12	Study forced damped vibrations of single degree of freedom system.
13	To determine whirling speed of the shaft and study effect of shaft diameter and end conditions on the same.
14	Study forced lateral vibration of a beam.
15	Study jump phenomenon in the cam.

(4)

a. **Course Name** Professionalism & Corporate Ethics
b. **Course Code:** 303193304
c. **Prerequisite:** Basic knowledge of SWOT analysis and understanding of the fundamentals of communication are essential.
d. **Rationale:** Soft skills and ethics are essential for career growth.
e. **Course Learning Objective:**

CLOBJ 1	Student will define and articulate the principles of professionalism in a corporate context.
CLOBJ 2	Student will be able to develop the ability to analyse ethical dilemmas and make informed decisions.
CLOBJ 3	Student will apply ethical decision-making models to real-world business scenarios
CLOBJ 4	Student will evaluate the impact of corporate activities on various stakeholders, including the community and the environment.
CLOBJ 5	Student will be able to understand and practice proper business etiquette in various communication channels.
CLOBJ 6	Student will be able to develop skills in resolving conflicts ethically and professionally.

f. **Course Learning Outcomes:**

CLO 1	Identity and develop soft skills required for personal and professional growth.
CLO 2	Develop professional etiquette & desired behaviour at the workplace
CLO 3	Speak and participate effectively in oral organizational communication
CLO 4	Improve comprehensive skills for reading.
CLO 5	Know how to be assertive in professional environment

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**1**	**0**	**1**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Topic	Weightage (%)	Teaching Hrs.
1	**Ethics in Engineering**: Scope of engineering ethics, Accepting & sharing responsibility, Responsible professionals and ethical corporations, Resolving ethical dilemmas, Case studies	**20**	**5**
2	**Group Discussion**: Communication core, Definition, types, process, guidelines, Mock round -1	**15**	**3**
3	**Introduction to B-School Tests**: Students will be able to solve verbal questions from the following exams. In these sessions students will learn to distinguish between national & international level of Management exam, GMAT, CAT.	**15**	**2**
4	**Listening Skills- Advanced Level**: Demonstrate ability to listen more than two minutes of audio clips & solvequestions based on it.	**10**	**1**
5	**Preparing Brochures**: Students will learn how to establish the purpose of writing & determineaudience they are writing for.	**15**	**2**
6	**Agenda & Minutes of Meeting**: Students will be able to explain what an agenda & minutes of meetingare and why they are useful.	**15**	**1**
7	**Reading Comprehension; Intermediate level**: Students will develop their ability to skim for main idea(s). They will able to make use of contextual clues to infer meaning of unfamiliar words from context and will be able to solve questions based on it.	**10**	**1**
	Total	**100**	**15**

i. Reference Books:

1. Business Correspondence and Report WritingSHARMA, R. AND MOHAN, K.
2. Ethics in Engineering Practice and Research Caroline Whitbeck, Cambridge UniversityPress.
3. Technical Communication: Principles And Practice Sangeetha Sharma, Meenakshi Raman; Oxford University Press.
4. How to prepare for verbal ability and reading comprehension for the CAT Arun Sharma, Meenakshi Upadhyay, TATAMcGraw HILL.

(5)

a. **Course Name:** Power Electronics
b. **Course Code:** 303113331
c. **Prerequisite:** Semiconductor Physics, Electronic Devices and Circuits, Electrical Machines
d. **Rationale:** This course provides strong foundation for understanding and designing of domestic and industrial power electronics circuits/ equipment's. Students can understand the conversion of power from AC to variable DC, Fixed DC to Variable DC, DC to variable AC using power electronics circuits. This subject also helps in understanding the speed control of DC and AC drives and design of UPS and SMPS.
e. **Course Learning Objective:**

CLOBJ1	Develop a comprehensive understanding of power electronic circuits, devices, and systems, exploring their fundamental principles and applications in converting and controlling electrical power.
CLOBJ2	Apply theoretical knowledge to analyze, design, and implement various power electronic converters, such as rectifiers, inverters, and choppers, considering efficiency, stability, and reliability.
CLOBJ3	Demonstrate proficiency in selecting and utilizing power semiconductor devices, such as diodes, transistors, and thyristors, to optimize performance and efficiency in electronic power systems.
CLOBJ4	Evaluate and troubleshoot power electronic circuits, recognizing and addressing issues related to thermal management, electromagnetic interference, and harmonic distortion.
CLOBJ5	Integrate emerging technologies and advancements in power electronics, fostering the ability to adapt and innovate in response to evolving energy conversion and control requirements.

f. **Course Learning Outcomes:**

CLO 1	Understand the power semiconductor devices
CLO 2	Design and analyse various SCR firing and commutation methods.
CLO 3	Explain the operation of phase-controlled rectification.
CLO 4	Understand the design and operation of various industrial based power electronics circuits like inverters & choppers.
CLO 5	Designing and repairing of SMPS, UPS, battery charger and circuit breakers.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Introduction to Power Semiconductor Devices Concept of Power Electronics, Applications of Power Electronics, Power Electronics Systems-Block Diagram, Types of Power Electronics Converters, Power Diode, Its V-I Characteristics & Reverse Recovery Characteristic, Types of Power Diodes, Freewheeling Action Using Diode, Terminal Characteristics of Thyristor, Switching Characteristics of Thyristor, Thyristor Gate Characteristics, Two Transistor Model of Thyristor, Thyristor Turn-On Methods, Thyristor Commutation Techniques, Thyristor Ratings, Thyristor Protection : Design of Snubber Circuit, Over Voltage Protection, Over Current Protection, Construction, Operation & Characteristics of Other Static Power Devices (Diac, Triac, BJT, MOSFET, GTOs, IGBT, UJT).	25	12
2	Phase Controlled Rectifiers Principle of Phase Control, Single Phase Full Wave Controlled Converter, Three Phase Full Wave Controlled Converter, Dual Converters, Some Worked Examples.	15	7
3	Choppers Principle of Chopper Operation- Step Down, Control Strategies, Step- Up, Types of Chopper Circuit: Type-A, Type-B, Type-C, Type-D and Type-E Chopper, Steady State Time Domain Analysis, Voltage and Current Commutated Chopper.	15	8
4	Inverters Single Phase Inverter (Operational Principle and Steady State Analysis), Fourier Analysis of Single-Phase Inverter Output.	15	7
5	Electric Drives Concepts Of Electric Drives, D.C. Drives, Half Wave Converter, Semi Converter & Full Converter Drive, Single Phase Dual Converter Drives, Three Phase Half Wave Converter, Semi Converter & Full Converter Drive, Dual Converter Drives, Chopper Drive, Power Control & Regenerative- Braking Control, Two Quadrant Chopper Drive, Performance of Induction Motors, Stator Voltage Control, Stator Frequency Control & Stator Voltage & Frequency Control.	20	7

6	Applications SMPS, UPS, Switches, Relay	**10**	**4**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Power Electronics by Dr P.S. Bhimbra.
2. Power electronics by M D Singh and K B Khanchandani.
3. Power Electronics - Circuits, Devices and Applications by Muhammad H. Rashid.
4. An Introduction to Thyristors and Their Applications by Ramamoorthy.
5. Power Electronics: Devices, Converters, Applications" By V. Subrahmanyam.
6. Modern Power Electronics by P. C. Sen.
7. Modern Power Electronics and AC Drives by Bimal. K. Bose.

j. Experiment List:

Sr. No.	**Experiment List**
1	To study, Perform & plot characteristics of Thyristor
2	To study, Perform & plot characteristics of DIAC
3	To study, Perform & plot characteristics of TRIAC.
4	To perform Resistance and RC triggered circuits of SCRs.
5	To study, Perform & plot UJT as a relaxation oscillator.
6	To perform the operation of single-phase half wave-controlled rectifier using RC phase shift triggering.
7	To study, Perform & observe the waveform of single-phase half converter with Resistive load.
8	To study, Perform & observe the waveform of single-phase full converter with resistive load.
9	To study, Perform & observe the waveform of step-up choppers
10	To study, Perform & observe the waveform of step-down choppers.
11	To study, Perform & observer the wave forms of series inverters.
12	To study, Perform & observer the wave forms of parallel inverters
13	To Perform operation of voltage commutated thyristor-based DC Chopper
14	To simulate operation of Buck Converter
15	To simulate operation of Boost Converter

a. **Course Name:** Data Structure and Algorithms

b. **Course Code:** 303113333

c. **Prerequisite:** Fundamentals of Knowledge of Programming & C Language

d. **Rationale:** This course is design to provide fundamentals of data structures. This subject provides basic knowledge of performance analysis and measurements and implementation of different data structure and algorithm using programming language.

e. **Course Learning Objective:**

CLOBJ1	Master fundamental data structures (arrays, linked lists, trees, graphs) and associated algorithms for efficient data manipulation.
CLOBJ2	Analyze algorithmic time and space complexity to make informed decisions for optimal performance.
CLOBJ3	Apply design paradigms (divide and conquer, dynamic programming, greedy algorithms) for systematic problem-solving.
CLOBJ4	Implement advanced data structures (hash tables, heaps, etc.) to address diverse computational challenges.
CLOBJ5	Collaborate effectively, communicating solutions to algorithmic problems clearly in team settings.

f. **Course Learning Outcomes:**

CLO 1	For a given algorithm student will able to analyse the algorithms to determine the time and computation complexity and justify the correctness.
CLO 2	For a given Search problem (Linear Search and Binary Search) student will able to implement it.
CLO 3	For a given problem of Stacks, Queues and linked list student will able to implement it and analyse the same to determine the time and computation complexity.
CLO 4	Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
CLO 5	Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis	13	6
2	**Stacks and Queues:** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation –corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.	23	11
3	**Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.	22	10
4	**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	22	10
5	**Sorting and Hashing:** Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.	12	5
6	**Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	8	3
	Total	100	45

i. Text Book and Reference Book:

1. An Introduction to Data Structures with Applications (Text Book) by Jean-Paul Tremblay, Paul G. Sorenson.
2. Data Structures using C & C++ by Tanenbaum.
3. Fundamentals of Computer Algorithms by E. Horowitz, S. Sahni, and S. Rajsekaran.
4. Fundamentals of Data Structures in C++ by Sartaj SahaniFeedback and Control Systems by Joseph J Distefano.
5. Data Structures: A Pseudo-code approach with C By Gilberg & Forouzan.

j. Experiment List:

Sr. No.	Experiment List
1	Introduction to pointers. (a) Call by Value (write a function that return max of two passed value) (b) Call by reference. (write a function to swap value of two variable) 1-B Introduction to Dynamic Memory Allocation DMA functions (a) W.A.P. to create dynamic int array (b) W.A.P. to create dynamic char array.
2	Write a program to implement structure in c. 2-B Write a program to implement (a) linear Search (b) Binary Search
3	Write a program to implement (a) Bubble Sort (b) Insertion Sort (c) Selection Sort Implement a program for stack that performs following operations using array. (a)PUSH (b) POP (c) PEEP (d) CHANGE (e) DISPLAY
4	Implement a program to convert infix notation to postfix notation using stack. Implement a program to evaluate postfix notation.
5	Write a program to implement QUEUE using arrays that performs following operations (a)INSERT (b) DELETE (c) DISPLAY Write a menu driven program to implement following operations on the singly linked list. (a) Insert a node at the front of the linked list. (b) Insert a node at the end of the linked list.
6	Write a menu driven program to implement following operations on the singly linked list. (a) Insert a node at the specified position (b) Delete a first node of the linked list. Write a menu driven program to implement following operations on the singly linked list. (a) Delete a node before specified position. (b) Delete a node after specified position.
7	Write a program to implement following operations on the doubly linked list. (a) Insert a node at the front of the linked list. (b) Insert a node at the end of the linked list. Write a program to implement following operations on the doubly linked list. (a) Delete a last node of the linked list. (b) Delete a node before specified position.
8	Write a program to implement following operations on the circular linked list. (a) Insert a node at the end of the linked list. (b) Insert a node before specified position. Write a program to implement following operations on the circular linked list. (a) Delete a first node of the linked list. (b) Delete a node after specified position.

9	Write a program to implement stack using linked list Write a program to implement queue using linked list
10	A- Write a program to create binary Tree Traversal. B- Write a program to implement Prim's and Kruskal's algorithm

(7)

a. **Course Name:** Automobile Engineering
b. **Course Code:** 303113335
c. **Prerequisite:** Knowledge of Physics and fundamentals of Mechanical Engineering.
d. **Rationale:** Study of this course is to get the understanding of construction and functions of basic mechanisms and structure of Automobile System responsible to generate required power, to transmit power for propelling vehicle, to control the vehicle during motion, other supporting systems like battery and vehicle electrical system.
e. **Course Learning Objective:**

CLOBJ1	Understanding of the basic working principles of engines and its Construction and Operation
CLOBJ2	To learn about the phenomena of Combustion and Design of Combustion Chambers
CLOBJ3	Engine Testing and Performance and Performance characteristics.
CLOBJ4	Learn the new technology instead of the pure I.C. Engine.

f. **Course Learning Outcomes:**

CLO 1	Identify the different parts of the automobile
CLO 2	Explain the working of various parts like engine, transmission, clutch, brakes
CLO 3	Describe how the steering and the suspension systems operate.
CLO 4	Understand the environmental implications of automobile emissions
CLO 5	Develop a strong base for understanding future developments in the automobile industry

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	Engine Construction and Operation Constructional details of 4-stroke engines. Working principle, Otto, Diesel cycle, Valve timing diagrams and actual indicator diagram. Diesel and Petrol fuels, Ignition quality. Octane & Cetane numbers	**10**	**5**
2	Two Stroke Engine & SI Engine Fuel System Construction and operation. Comparison of four stroke and two-stroke engine operation. Port timing diagrams. Firing order and its significance. Carburettor working principle. Requirements of an automotive carburettor; Starting, Idling, Acceleration and normal circuits of carburettors, Maximum power devices, Constant choke and constant vacuum carburettors. Fuel feed systems, Mechanical and electrical pumps. Petrol injection. LPG and CNG fuel systems. MPFI systems for petrol.	**20**	**10**
3	CI Engine Fuel System & Cooling and Lubrication System Fuel Injection System: Requirements, Air and solid injection, Function of components, Jerk and distributor type pumps. Pressure waves, Injection lag, Unit injector, Mechanical and Pneumatic governors. Fuel injector-types of injection nozzle, Spray characteristics, Injection timing, Pump calibration. CRDI systems for diesel. Need for cooling system. Types of cooling system, Liquid cooled system, Thermo-siphon system, and Pressure cooling system. Lubrication system, Mist lubrication system, Wet sump and dry sump lubrication. Properties of lubricants. Properties of coolants.	**20**	**10**
4	Combustion and Combustion Chambers & Types of Scavenging Combustion in IC engines, Stages of combustion, Flame propagation, Rate of pressure rise, Abnormal combustion, Knocks. Effect of engine variables on knock. Combustion chambers, Factor controlling combustion chamber design	**20**	**8**
5	Supercharging and Turbo charging Necessity and limitation, Charge cooling, Types of supercharging and turbo charging, relative merits, Matching of turbocharger	**15**	**6**
6	Engine Testing and Performance Characteristics Automotive and stationary, Engine testing and related standards. Engine power and efficiencies. Variables affecting engine performance. Methods to improve engine performance. Heat balance. Performance maps and drivability diagnosis.	**15**	**6**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Basic Automobile Engineering by C. P. Nakra.
2. Internal Combustion Engines by Ganesan. V.
3. Internal Combustion Engines by V.M. Domkundwar.
4. Automotive Engines by William H. Crouse and Donald Anglin.
5. Automotive Engines by Ellinger.H.E | Prentice Hall Publishers.

j. Experiment List:

Sr. No.	Experiment List
1	Study of various hand tools for maintenance and service of Automobile Systems Essential Automotive Tools are explained and analysed basically
2	Study of Vehicle Layout and flow of motion. Layouts can roughly be divided into three categories: front-wheel drive, rear-wheel drive and four-wheel drive.
3	Building of Chassis and Frame for Four-wheeler vehicle. A chassis is defined as the most basic framework for a manmade structure. ... As well as act as the frame onto which all of the vehicle's parts are attached,
4	Disassembly and assembly of Petrol Engine ability to Disassembly and assembly of Petrol Engine are studied
5	Disassembly and assembly of Diesel Engine Ability to Disassembly and assembly of Diesel Engine
6	Disassembly and assembly of Gear Box Ability to Disassembly and assembly of Gear Box
7	Disassembly and assembly of Differential. the learning ability to Disassembly and assembly of Differential
8	Disassembly and assembly Clutch and its operating mechanism. The principle behind working of clutches (friction) is that no torque/power gets transmitted until both the friction plates touch each other.
9	Disassembly and assembly of braking system. Most modern cars have brakes on all four wheels, operated by a hydraulic system. The brakes may be disc type or drum type.
10	A Mini Project on assembly of working or non-working model of conventional or modern automobile system A Mini Project on assembly of working or non-working model of conventional or modern automobile system

Semester 6

(1)

a. **Course Name:** Minor Project
b. **Course Code:** 303101358
c. **Prerequisite:** The students are required to identify their problem and they are required to follow all the rules and instructions issued by department, for safety and other requirements.
d. **Rationale:** To understand the basic theory, study of the particular Systems/Services/Processes in the context of the abstract problem area/s. After understanding the student will analyse the information, prepare list of probable requirements, the questions if any, the probable forecasting of hurdles which might be observed in future and finding the way outs.
e. **Course Learning Objective:**

CLOBJ 1	Integrate mechanical, electrical, and computer systems, selecting and interfacing sensors, actuators, and controllers for a cohesive mechatronic system.
CLOBJ 2	Proficiently code in C/C++ or Python, implementing control algorithms for precise mechatronic system control.
CLOBJ 3	Select and integrate sensors and actuators, demonstrating hands-on calibration for reliable mechatronic system performance.
CLOBJ 4	Manage projects effectively, setting milestones and deadlines, while documenting specifications, design decisions, and implementation details.
CLOBJ 5	Identify and resolve issues, learning optimization techniques for mechatronic systems considering power efficiency, speed, and precision.

f. **Course Learning Outcomes:**

CLO 1	Demonstrate a holistic understanding of mechatronics principles through the design and integration of mechanical components with electronic systems in a practical project.
CLO 2	Showcase practical competence in mechatronics by selecting, interfacing, and programming sensors and actuators for seamless integration into a mechatronic system.
CLO 3	Attain proficiency in real-time control of mechatronic systems, mastering microcontroller programming, and implementing feedback control algorithms along with dynamic response analysis.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	20	-	30	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No	Content	Weightage (%)	Teaching Hours
1	**Content** Student has to prepare product based on the subjects learned till date. The student has to submit report of the project and evaluation will be done at department level and through external examiner as per teaching scheme.	100	30
	Total	100	30

(2)

a. **Course Name:** Industrial Automation
b. **Course Code:** 303113351
c. **Prerequisite:** Basic knowledge of Digital Electronics, Integrated circuits and applications (op-amps), sensors and transducer are required.
d. **Rationale:** The purpose of this course is to teach students the fundamentals of automation used in industries.
e. **Course Learning Objective:**

CLOBJ 1	Define key concepts, explain principles, and identify components of industrial automation, encompassing technologies like PLCs systems.
CLOBJ 2	Develop the ability to design, program, and troubleshoot control systems using PLCs, ensuring efficient and effective industrial automation.
CLOBJ 3	Evaluate, select, and integrate sensors for process monitoring, while incorporating actuators and troubleshooting to ensure reliable data acquisition and control.
CLOBJ 4	Apply safety protocols and standards, implement fail-safe mechanisms, and identify and mitigate potential hazards, ensuring reliability and safety in automated systems.
CLOBJ 5	Analyse, assess, and optimize industrial processes by identifying areas for automation improvement, implementing energy-efficient strategies, and using data analytics for continuous enhancement.

f. **Course Learning Outcomes:**

CLO 1	To develop a solid understanding of basic principles and components of Programmable Logic Controllers.
CLO 2	To acquire programming skills for PLCs using industry-standard languages such as ladder logic, function block diagrams, or structured text.
CLO 3	To gain expertise in troubleshooting common issues related to PLCs.
CLO 4	To understand how PLCs integrate with other industrial automation components and systems, such as sensors, actuators, and Human-Machine Interfaces (HMIs).
CLO 5	To apply PLC knowledge to real-world industrial scenarios through hands-on projects.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Logical Process Control in Automation** Introduction to process control, Continuous Process Control, Discrete- state Process Control, Composite Process Control, Data logger, DDC, SCADA, Scope of automation in industry.	12	6
2	**PLC Architecture** Introduction to PLC, Configuration of PLC (components for modularized PLC), Architecture of PLC, Working of PLC, PLC peripherals, PLC symbols, Selection criteria of PLC, Advantages and disadvantages of PLC, PLC applications.	10	5
3	**PLC Peripherals and Wiring** Analog input/ output module, Digital input/ output module, Switching devices (level, pressure, flow, temperature, timer, proximity switch), PLC input/output connection. PLC power connection (wiring). Isolated and non-isolated input/output wiring to PLC.	16	8
4	**Relation to Digital Gate Logic to Contact/ Coil Logic** Introduction to General PLC Programming Procedures. Programming equipment-Hand held programmer, Programming sequence, PLC Ladder Diagrams, Process scanning consideration, PLC operational fault. -NOT, AND, OR, NAND, NOR, Ex-OR, Ex-NOR logic.	12	6
5	**Creating Ladder Diagrams** PLC Programming languages, Boolean algebraic equation, holding (latching relay) contact, Branching and complex branching ladder rung.	21	8
6	**PLC Basic functions** PLC timer, counter, arithmetic functions, PLC Number comparison functions, Numbering systems and PLC number conversion function, PLC skip and master control relay functions - JUMP functions- PLC data moves systems, Digital bits, Sequential, controlling a robot with PLC, Analog PLC operations, PID control of continuous process, networking of PLCs, PLC Installation, Trouble shooting and maintenance.	17	8
7	**Data Acquisition and Integration of Automation System** Introduction of Data Acquisition system, Data Acquisition	12	6

	system using GPIB, Data Acquisition system using Serial Interface, Introduction, levels of Industrial Control, Types of Networking, Network Communication, PLC and the Internet, Cell control by PLC networks, Hierarchy model of industrial automation, network data communication, Local area networks and its characteristics, Network Devices, Field buses, Profibus, Modbus, FFB.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "8051 Microcontroller & Embedded system using assembly & C" by Muhmmad Mazidi.
2. "8051 microcontroller & Embedded system using assembly & C" by K J Ayala.
3. "Programming and Customizing the 8051 Microcontroller" by Myke Predko.
4. "The 8051 Microcontrollers, Architecture and programming and Applications" by K.Uma Rao, AndhePallavi.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Types of Engineering Materials, study about the different types of material and metals.
2	To study about Metallurgical Microscope, know about the metallurgical microscope and its detail analysis.
3	Specimen Preparation for Micro examination, to study about metallography technique.
4	Micro Examination of standard specimen, understand about different types of materials and its structure with respect to the application in industrial point of view.
5	Demonstration of Heat Treatment of steel, understand about the different stages of heat treatment and its importance in ferrous and non-ferrous metals application.
6	Study of Powder Metallurgy process, to get the knowledge about different stages of powder metallurgy steps and it application.
7	Demonstration of Ultrasonic Flow Detector, to understand the basic concept of ultrasonic testing method.
8	To study Magnetic Particle Testing, to get the details about magnetic particle testing method and its application to find out the defect in different ferrous metals.
9	To study Dye penetrating test, to get the basic idea about the steps of dye penetrating testing method in ferrous and nonferrous metals.
10	Demonstration of Jominy end quenching test, to understand the basic concept about hardenability and its importance to define the properties of materials.

(3)

a. **Course Name:** Manufacturing Process II
b. **Course Code:** 303113353
c. **Prerequisite:** Fundamentals of Materials and it's property.
d. **Rationale:** Which type of process is used for manufacturing product is an essential to know for Engineer.
e. **Course Learning Objective:**

CLOBJ 1	Analyse and optimize manufacturing processes through advanced application of material selection, machining, and assembly principles for enhanced efficiency and product quality.
CLOBJ 2	Apply advanced process planning and control concepts to effectively manage production operations, ensuring compliance with industry standards and regulations.
CLOBJ 3	Master cutting-edge manufacturing technologies, including CNC machining and additive manufacturing, for innovative and improved product development.
CLOBJ 4	Implement strategies for cost reduction and waste minimization in manufacturing, integrating lean practices and sustainable approaches.
CLOBJ 5	Develop expertise in quality assurance and statistical methods to identify and resolve manufacturing defects while maintaining consistent product standards.

f. **Course Learning Outcomes:**

CLO 1	To define and explain the economic and technological significance of manufacturing in modern society.
CLO 2	To evaluate casting practices, including defect identification, design considerations, gating systems, riser designs, and melting furnace types.
CLO 3	To demonstrate proficiency in oxyacetylene welding, arc welding, gas welding and cutting, resistance welding, and various special welding processes.
CLO 4	To describe the principles, operations, and tools associated with rolling, forging, extrusion, blanking, piercing, deep drawing, and other metal forming operations.
CLO 5	To explain the design principles behind various cutting tools, such as single-point cutting tools, milling cutters, reamers, taps, broaches, and press tools.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction** Importance of manufacturing, economic and technological definition of manufacturing, Classification of manufacturing processes, Selection of Manufacturing process.	5	2
2	**Casting Process** Types of patterns, allowances and material used for patterns, moulding materials, Moulding sands; properties and sand testing. **Casting practices:** Fundamental about types of Casting, Casting defects, Design of casting, Gating system and riser design & it's effect on Product and Process. Types of Melting furnaces	30	14
3	**Welding Process:** Principle of welding. Classification of welding processes. Principle of Oxyacetylene welding and its equipment, Flame cutting. Arc welding, Power sources and consumables, Gas welding and cutting, Principle, Processes and Equipment's of: Resistance welding (Spot, Projection and seam) welding process, atomic hydrogen, ultrasonic, Plasma and laser beam welding, Electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, Welding defects.	28	12
4	**Forming Process**: Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold working, Principle, operations and tools of: Rolling Process, Forging Process, Extrusion processes. Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, Metal working defects, cold heading, Riveting, Thread rolling bending and forming operation.	22	10
5	**Tool Design:** Design of Single point Cutting Tool, Milling Cutters, Rimmers, taps and broaches, Case study on Press Tool Design and Bending, forming and drawing dies.	15	7
	Total	100	45

i. Text Book and Reference Book:

1. “Fundamentals of Metal Casting Technology by P.C. Mukherjee.
2. P C Sharma, “A Textbook of Production Engineering”.
3. “Metal Castings – Principles & Practice” by T.V. Ramana Rao.
4. “Welding processes and technology” by Dr.R.S.Parmar.
5. “Production Technology” by R.K. Jain.
6. “Nonconventional Machining” by P K Mishra.
7. “Metal forming: Processes and Analysis” by B. Avitzer

j. Experiment List:

Exp. No.	Name of the Experiment
1	To emphasise the importance of manufacturing activity and to get an overview of the various manufacturing processes.
2	Study the different types of patterns and cores and also prepare a pattern of a wooden block.
3	(A) To study requirements and methods of (a) Sand Preparation (b) Moulding (c) Sand testing (B) To practically conduct preparation of sand & mould for a particular job. Perform the various sand tests of same.
4	Study the different casting methods and cast the given product.
5	Performance of gas welding and gas cutting process.
6	Demonstration on TIG and MIG Welding.
7	To study the working principle of Resistance Welding process.
8	To study the basic concept of press working operations
9	To study Injection moulding process.
10	Study and measure the Spring Back effect in V bending

(4)

a. **Course Name:** Computer Aided Design and Analysis
b. **Course Code:** 303113355
c. **Prerequisite:** NA
d. **Rationale:** CAD for mechatronics give students greater depth of technical knowledge in the areas of design using modelling and analysis software's. To learn detailed engineering of 3D models and application of computer system to a solution of design problem.
e. **Course Learning Objective:**

CLOBJ 1	Acquire proficiency in utilizing Computer-Aided Design (CAD) software to create 2D and 3D models for engineering applications.
CLOBJ 2	Develop skills in analysing and evaluating designs through simulation and analysis tools, ensuring structural integrity and performance.
CLOBJ 3	Explore advanced techniques for parametric modelling, assemblies, and product documentation in the context of computer-aided design.
CLOBJ 4	Demonstrate competence in utilizing Finite Element Analysis (FEA) to assess and optimize the performance of engineering components and systems.
CLOBJ 5	Apply industry-standard practices in computer-aided design to effectively communicate and collaborate in the development of engineering solutions.

f. **Course Learning Outcomes:**

CLO 1	Proficiently create 2D and 3D models using CAD software for engineering applications.
CLO 2	Evaluate designs for structural integrity and performance using simulation and analysis tools.
CLO 3	Apply advanced parametric modelling techniques for assemblies and product documentation.
CLO 4	Utilize Finite Element Analysis (FEA) to assess and optimize engineering components and systems.
CLO 5	Effectively communicate and collaborate using industry-standard practices in computer-aided design for engineering solutions.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction** Product cycle, sequential and concurrent engineering, Computer Aided Design.	15	5
2	**COMPUTER GRAPHICS** Scan conversion, DDA and Bresnaham's algorithms for generation of line and circle. 2D and 3D Transformations.	20	10
3	**GEOMETRIC MODELING** Curves introduction: Analytic curves, synthetic curves, Hermite cubic spline, Bezier curve, B-spline curve and NURBS. Surface's introduction: Surface entities, analytic surfaces, synthetic surfaces such as Hermite cubic, Bezier, B-spline. Solid's introduction: Geometry and topology, solid entities, sweeps, solid manipulation, CSG and B-rep, faceted models i.e. STL, HSD i.e. Octree Features & Feature based models.	25	13
4	**Forming Process**: Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold working, Principle, operations and tools of: Rolling Process, Forging Process, Extrusion processes. Squeezing, Blanking, Piercing, deep drawing, Coining and embossing, Metal working defects, cold heading, Riveting, Thread rolling bending and forming operation.	25	12
5	**Tool Design:** Design of Single point Cutting Tool, Milling Cutters, Rimmers, taps and broaches, Case study on Press Tool Design and Bending, forming and drawing dies.	15	5
	Total	100	45

i. Text Book and Reference Book:

1. “CAD/CAM Theory & Practice” by Ibrahim Zeid.
2. “CAD/CAM Principles” by C. McMohan and J. Browne.
3. “Principles of Computer Graphics” by W. M. Neumann and R.F. Sproul.
4. “Computer Graphics” by Donald Hearn & M. Pauline Baker.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Introduction to CAD Tools and Hardware.
2	Programming exercise for plotting of line and Circle.
3	Programming exercise for Transformations.
4	Surface modelling using industry relevant software.
5	Solid modelling using industry relevant software.
6	Exercises for estimating surface and mass properties of model.
7	Assembly modelling using industry relevant software.
8	Comparison of numerical solutions of simple structural problem using FEA software.
9	Programming exercise for stress analysis 2-D truss subjected to plane forces.
10	Case study on Implementation of CAD in industry.

(5)

a. **Course Name:** Hydraulic and Pneumatic Systems
b. **Course Code:** 303122351
c. **Prerequisite:** Basic knowledge of Physics.
d. **Rationale:** This course gives the basic knowledge of components and functions of hydraulic and pneumatic systems. Also provides different theories and applications of hydraulic and pneumatic power/control systems.

e. **Course Learning Objective:**

CLOBJ 1	Grasp foundational principles for efficient design of hydraulic and pneumatic systems.
CLOBJ 2	Interpret schematics proficiently to troubleshoot and identify system components and faults.
CLOBJ 3	Calculate and predict system performance parameters through mathematical analysis and simulations.
CLOBJ 4	Apply automation and control principles to design advanced systems with enhanced functionality and precision.

f. **Course Learning Outcomes:**

CLO 1	Understand the knowledge about hydraulic and pneumatic systems.
CLO 2	Control motions through hydraulic and pneumatic systems.
CLO 3	Understand behaviour of working media in hydraulic and pneumatic systems.
CLO 4	Do automation by integrating electrical and mechanical components in hydraulic and pneumatic systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation,
CE- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction** Basics of Hydraulics & Pneumatic Systems, advantages and disadvantages, Comparison between mechanical, electrical, hydraulic and pneumatic power transmission, Principles of Hydraulic Fluid power (Pascal law, application of Pascal law, continuity equation, flow rate).	5	2
2	**Hydraulic System and its Components** Hydraulic Pumps & Motors: Classification of hydraulic pumps, G Pumps, Vane Pumps, Radial piston Pumps, Axial piston Pumps, Hydraulic motors, Selection of Hydraulic Pumps. Actuators: Linear and Rotary Actuators, Hydrostatic Transmission Systems. Hydraulic Valves: Direction control valves, Pressure control valves, Flow control valves, Nonreturn valves, Electro-Hydraulic Servo valves. Hydraulic system Accessories: Reservoirs, Accumulators, Heating & cooling devices Fluid Properties: Types, Properties, physical characteristics & functions of hydraulic Oils, Classification Mineral based, Fire resistant& Biodegradable Oils Filters & location of filter.	40	18
3	**Design of Hydraulic Circuits** Symbols, Control of single acting and double acting cyclometer in and meter out circuits, regenerative circuits, application, automatic cylinder reciprocating, fail safe circuit, pump unloading circuits, Power losses in flow control circuits.	12	6
4	**Pneumatic System and its components** Basic Requirements for Pneumatic System, Applications, and Ty Selection criteria for Air Compressors, Air receiver, FRL filter Pressure regulator and Lubricator. Pneumatic Actuators, Motors and Valves: Types of Pneumatic Cylinders & Air motors, Cushion assembly, mounting Arrangements, Pneumatic Direction control valves, Quick exhaust, Time delay Shuttle and Twin pressure valves.	26	12
5	**Design of Pneumatic Circuits** Symbols, control of single acting & double acting cylinder by various methods, impulse operation, speed control of a cylinder, sequencing of motions, automatic cylinder reciprocating, delay circuits, logic operation circuits, circuits by cascade systems.	12	5
6	**Electro Hydraulics and Electro-Pneumatics** Overview and applications, System components, Development of single and multiple Actuator Circuits.	5	2
	Total	100	45

i. Text Book and Reference Book:

1. "Basic Pneumatic Systems, Principle and Maintenance" by S R Majumdar.
2. "Hydraulics & Pneumatics" by Andrew Parr.
3. "Pneumatic and Hydraulic components and instrumentation in automatic controls" by Leskiewics H.J. and Zarhmba M.
4. "Fundamentals of Hydraulic Circuitry" by Dr. Heinza Zoebl.
5. "Oil Hydraulic Systems" by S R Majumdar.
6. "Industrial Hydraulics" by John Pippenger& Taylor Hicks.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Graphical Symbol as per DIN-ISO: 1219.
2	To understand working and construction of hydraulic components and basic circuits.
3	To understand working and construction of Pneumatic components and basic circuits
4	Circuit design for Speed control of hydraulic cylinders. (Meter-In, Meter-Out and Bypass circuits).
5	Electro hydraulic circuit-Speed control of double acting hydraulic cylinder.
6	Electro Hydraulic circuit-Sequential operation through Limit Switches.
7	To control Double acting pneumatic cylinder through 5/2 D.C. Valve & by 3/2 push button valves and Shuttle Valve.
8	To understand the logic system for pneumatic system.
9	To understand use of Quick exhaust, Flow control and Time Delay valve.
10	Control of Double acting pneumatic cylinder.
11	To control double acting pneumatic cylinder through 5/2 solenoid operated DCV.

(6)

a. **Course Name:** Employability Skills
b. **Course Code:** 303193353
c. **Prerequisite:** Basic knowledge of ethics, corporate etiquettes and understanding of the fundamentals of communication are essential.
d. **Rationale:** Interpersonal skills and employability skills are essential for better career.

e. **Course Learning Objective:**

CLOBJ 1	Students will be able to understand the importance of resume customization for different job applications.
CLOBJ 2	Students will develop strategies for identifying job opportunities through various channels.
CLOBJ 3	Students will demonstrate proficiency in preparing for job interviews.
CLOBJ 4	Students will build and expand a professional network using both online and offline channels.
CLOBJ 5	Students will be able to understand workplace communication dynamics, including formal and informal channels.
CLOBJ 6	Students will be able to apply time management techniques to prioritize tasks and meet deadlines.

f. **Course Learning Outcomes:**

CLO 1	Get ready for IELTS tests.
CLO 2	Develop a professional resume.
CLO 3	Get an understanding of the interview process.
CLO 4	Improve employability skills through mock tests.
CLO 5	Use soft skills during job interviews.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**1**	**0**	**1**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. no.	Topic	Weightage (%)	Teaching Hrs.
1	**IELTS Mock Test**: To develop students English Learning and improve their employment prospects. To create opportunity for students to study around the globe & give them Practice on: Listening Speaking Reading Writing	**25**	**5**
2	**Resume Building**: Cover letter & Resume Writing Students will create a functional resume along with cover letter that they will be able to use when applying for a job, college or a scholarship.	**25**	**2**
3	**Advanced Group Discussion: Mock Round**: To provide students with an avenue to train themselves in various interpersonal skills. To prepare students for the Group Discussion after the written test for employment or for admission to educational institutes. To generate new ideas or new approaches for solving a problem. To reach a solution on an issue of concern.	**25**	**4**
4	**Personal Interview: Mock Round**: Preparing for the Interview, Review Question, Employer's Expectation, Case Interview.	**25**	**4**
	Total	**100**	**15**

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Communication Skills and Soft Skills Suresh Kumar; Pearson Publication, 2010
3. Technical Communication: Principles And Practice Sangeetha Sharma, Meenakshi Raman; Oxford University Press

(7)

a. **Course Name:** Fluid Power Engineering
b. **Course Code:** 303113381
c. **Prerequisite:** Basic knowledge of physics and fluid mechanics
d. **Rationale:** This course gives the basic knowledge of components and functions of fluid operated machines to generate power. Also provides different theories and applications of fluid power/control systems.
e. **Course Learning Objective:**

CLOBJ 1	Master the principles of fluid mechanics for analysing fluid power systems.
CLOBJ 2	Develop expertise in designing and troubleshooting hydraulic and pneumatic circuits.
CLOBJ 3	Acquire practical skills in assembling, installing, and maintaining fluid power systems with a focus on safety and environmental considerations.
CLOBJ 4	Apply advanced concepts for designing precise hydraulic and pneumatic applications, including proportional control and automation.

f. **Course Learning Outcomes:**

CLO 1	Understand and apply fluid mechanics principles for analysing fluid power systems.
CLO 2	Design and troubleshoot hydraulic and pneumatic circuits for optimal performance.
CLO 3	Demonstrate hands-on skills in assembling, installing, and maintaining fluid power systems with a focus on safety and environmental considerations.
CLO 4	Apply advanced concepts like proportional control and automation for designing precise hydraulic and pneumatic applications, showcasing problem-solving abilities.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Impact of Free Jets:** Impulse momentum principle, Force exerted by the jet on stationary flat and curved plate, Hinged plate, moving flat plate and moving curved vanes, Force exerted on moving plate held normal and inclined in direction of moving jet, jet striking on curved vane tangentially at one tip and leaving at other end, Jet propulsion of ship, Jet striking on series of flat and curved vanes.	**20**	**9**
2	**Turbo machinery:** Introduction, Basic principles, Classification, Impulse & Reaction type, Hydropower Plant-Introduction, Essential components of hydropower plant, Classification of hydropower plant, Fundamental equations, Euler's equation. Impulse Turbine: Classification of turbine, Impulse turbine, Pelton wheel, Construction working, work done, Head & efficiencies and Design aspects, Governing of impulse turbine.	**20**	**7**
3	**Reaction Turbine:** Radial flow reaction turbine, Francis's turbine: construction & working, work done, efficiency, design aspect, advantages & disadvantages over Pelton wheel. **Axial flow reaction turbine:** Propeller and Kaplan turbine, Bulb or tubular turbine, Draft tube, Specific speed, Unit quantities, Cavitation, Degree of reaction, Performance characteristics, Governing of reaction turbine.	**20**	**7**
4	**Centrifugal Pumps:** Classification of Pumps, Centrifugal pump, Construction, working, Work done, Heads, Efficiencies, Multistage centrifugal pump, Pump in series and parallel, Specific speed, Characteristic, Net positive suction head, Pressure rise in impeller, minimum starting speed to deliver the discharge, Cavitation, Priming.	**10**	**5**
5	**Reciprocating Pumps:** Classification, Component and working, Single acting and double acting, Discharge, work done and power required, Coefficient of discharge, air vessels.	**10**	**4**
6	**Compressors: Reciprocating Compressors:** Construction and working, Multistage conditions for minimum work, Inter-cooling, Efficiency and control of air compressors. **Centrifugal Compressors:** Essential parts, Velocity diagram, Degree of reaction, surging and choking, Losses in centrifugal compressor.	**10**	**9**

	Axial Flow Compressors: Construction of an axial flow compressor, Lift and drag, Performance characteristics		
7	**Fluid system:** Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, Hydraulic crane, Hydraulic lift, Hydraulic Ram, Hydraulic coupling, Hydraulic torque converter, Air lift pump, Jet pump.	**10**	**4**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Hydraulics, Fluid Mechanics and Hydraulic machine" by R K Bansal.
2. "Fluid Mechanics & Hydraulics Machines" by Dr. R K Rajput.
3. "Fluid Mechanics and Fluid Power Engineering" by D.S. Kumar.
4. "Introduction to Fluid Mechanics and Fluid Machines" by S.K. Som & G. Biswas.
5. "Hydraulics and Fluid Mechanics" by Modi & Sheth.
6. "Mechanics of Fluid" by Massey B.S.
7. "Hydraulic Machines" By Jagdish Lal.

j. Experiment List:

Exp. No.	**Name of the Experiment**
1	To study about hydropower plant
2	To verify impulse momentum principle- Impact of jet on stationary vane
3	Performance test on Reciprocating Compressor.
4	Performance test on centrifugal pump
5	Performance test of reciprocating pump
6	Performance test on Centrifugal Blower.
7	To study about hydraulic machines
8	Performance test on Pelton wheel turbine
9	Performance test on Francis Turbine
10	Performance test on Kaplan Turbine
11	Performance test on Hydraulic Ram Pump

(8)

a. **Course Name:** Advanced Micro-Computing Systems
b. **Course Code:** 303113383
c. **Prerequisite:** Inclination to learn mathematics, basic knowledge of C and C++ programming, interfacing of device, DC motor & servo motor.
d. **Rationale:** To add luxury in life automation is required in all applications for that we need embedded system, where we don't need user intervention. By learning this course student can develop their own embedded system which is application specific to solve given real time problem by using open-source platform. Thus, this course is an important course for students who want to work in the automation sector of industry.
e. **Course Learning Objective:**

CLOBJ 1	Master advanced microprocessor architectures, including pipelining and multi-core designs, analysing their impact on system performance.
CLOBJ 2	Develop embedded systems using advanced microcontrollers, incorporating real-time operating systems (RTOS) for optimal functionality.
CLOBJ 3	Explore advanced memory hierarchies, including cache architectures and virtual memory systems, while mastering memory management techniques and optimizations.
CLOBJ 4	Dive into parallel and distributed computing concepts, designing and optimizing algorithms for parallel execution in both shared and distributed environments.

f. **Course Learning Outcomes:**

CLO 1	Understand microcontroller-based system.
CLO 2	Select appropriate family of microcontroller for different applications.
CLO 3	Interface relevant hardware for given application.
CLO 4	Develop programme for given application.
CLO 5	Integrate hardware and software for embedded system for given application.
CLO 6	Identify and understand function of different blocks of PIC microcontroller.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to Atmega328Microcontroller:** Features of Atmega328, Pin Descriptions, Block Diagram, Comparison Between different microcontrollers of Atmega family, Atmega328 for Arduino environment.	25	12
2	**Open-Source Embedded Arduino Development Board:** Arduino: Birth, Open-Source community, Functional Block Diagram of Arduino, Functions of each Pin of Arduino, Arduino Development Board diagram (including different blocks only): IDE, I/O Functions, Looping Techniques, Decision Making Techniques, Designing of 1st sketch, Programming of an Arduino (Arduino ISP), Arduino Boot loader.	25	12
3	**Interface Digital and Analog I/O Devices with Arduino:** Basic Interfacing and I/O Concept, Interfacing LED, Switch,7-seg LED and its Code, interfacing keypad, Concept of ADC, interfacing analog Input, interfacing analog Sensors, Initialization for serial port and programming of serial port, Interfacing 16x2 LCD and its programming, Use of External Interrupts in Arduino.	20	7
4	**Embedded system Applications:** Controlling a DC motor (PWM), Interfacing L293D with Arduino, interfacing a Bluetooth Module, Interfacing of Ultrasonic Module, interfacing a Servo Motor, LCD Interfacing Code for Home automation using PIR sensor and its Control.	15	7
5	**Basic concept of PIC16Fxx microcontroller:** PIC Microcontroller Architecture, Watchdog Timer, PIC16FFamily, PIN connection, Configuration Registers, Arithmetic and Logical Operations, I/O Programming.	15	7

	Total	100	45

i. Text Book and Reference Book:

1. "Exploring Arduino" by Jeremy Blum.
2. "PIC Microcontroller and Embedded Systems" by Mazidi M. A., McKinlay R. D., Causey D.
3. "Beginning Arduino" by Michael Patterson.
4. "Arduino Cookbook" by Michael Margo.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Develop a program to Blink LED for 1 second using Arduino Development Board.
2	Develop a program to interface Input Switches and Output LEDs with Arduino Development Board.
3	Interface 7 segment display with Arduino Development Board and Write a program to count and display 0 to 9 on it.
4	Interface potentiometer with Arduino development board and write a program to generate Led pattern on it.
5	Interface LM35 temperature sensor with Arduino and monitor temperature on serial monitor.
6	Interface DC motor using L293D Motor Driver.
7	Interface 16x2 LCD and Display "HELLO WORLD".
8	Built a distance measurement meter using Ultrasonic Sensor and LCD interfacing using Arduino Development Board.
9	Interface PIR Sensor with Arduino development board and write a program for motion sensed home lights.
10	Write a program to interface Bluetooth module with Arduino Development Board.

(9)

a. **Course Name:** Mechanical Component Design
b. **Course Code:** 303113385
c. **Prerequisite:** Basic understanding of mechanics of solid, concepts of mechanical design and industrial drafting.
d. **Rationale:** The course will introduce undergraduate students to the concept of design of machine component.
e. **Course Learning Objective:**

CLOBJ 1	Learn how to design strong and effective mechanical parts by understanding stress and choosing the right materials.
CLOBJ 2	Become skilled at using computer tools to create precise and easily manufacturable designs for mechanical components.
CLOBJ 3	Understand more advanced aspects of mechanical component design, like how things move, behave under forces, and what causes them to fail.
CLOBJ 4	Use optimization methods and current standards to make smart and eco-friendly designs for mechanical components in various uses.

f. **Course Learning Outcomes:**

CLO 1	Relate knowledge of material science in order to select appropriate material for designing various components of machines.
CLO 2	Understand various failure modes of machine components subjected to different loading conditions.
CLO 3	Apply the concepts of stress analysis, theories of failure to design various components of machines.
CLO 4	Design important components of various mechanical systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction:** Design procedure, Selection of preferred sizes, Aesthetic and Ergonomic considerations in Design, and Manufacturing considerations in Design, Mechanical Properties of Materials, Effect of Alloying elements and heat treatment on properties of steels, Material Selection in Machine Design, IS coding of steel and Cast Iron.	15	5
2	**Design of Springs:** Classification of springs, Helical Spring: Style of ends, Stresses, Correction Factors, and Deflection, Design against static and fluctuating loads, Concentric springs, surge phenomenon. Helical Torsion and Spiral Springs, Belleville, spring, shot peening of springs. Multi-Leaf Spring: Terminology, Nipping, and Design of multi-leaf spring.	20	8
3	**Belt and Chain Drives:** Flat Belt Drive: Belt Construction, Flat Belt Drive: Length of the Belt: Open and Cross drive types, Ratio of Tensions on tight side to slack side, Condition for maximum power transmission, Creep phenomenon, Methods for tensioning, Selection of Belts from catalogues, and Design of Pulley for flat belt drive. Timing belt selection. V-Belt Drive: Nomenclature, Selection of V-Belts from catalogues. Chain Drive: Nomenclature of roller chains, Length and power rating of chains, Design of chain drive. Design of pulley and wire rope.	25	12
4	**Bearings:** Antifriction Bearing-Types of ball bearings, roller bearings, needle bearings, friction life of bearings, reliability considerations, selection of ball bearings, roller bearing, tapered roller bearing, thrust bearing, lubrication and sealing, Mounting of bearings. Lubrication and sliding bearings-Type of lubrication, viscosity, hydrodynamic theory of lubrication, types of bearing, design of bearing using design charts, boundary lubrication, hydrostatic bearing and hydrodynamic thrust bearings.	20	12
5	**Pressure Vessels:** Thin cylinders and spherical vessels, Wire wound cylinders. Thick cylinders: Principal stresses in cylinder subjected to internal/external pressure, Lame's equation, Clavarino's and Bernie's equations, Autofrettage, Compounding of cylinders, Gasketted Joints, Thickness of cylindrical and spherical shells, Design of End closures, Area compensations for nozzles. Introduction to Design	20	8

	codes.		
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Machine Design (TextBook)" by Sadhu Singh.
2. "Machine Design an Introduction" by R L Norton.
3. "Design of Machine Elements" by V B Bhandari.
4. "Machine Design Vol - II & III by F.Haideri.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Exercise based on design considerations and material selection.
2	Exercise to design helical spring and leaf spring.
3	Exercise to design belt drive and chain drive.
4	Exercise to design pulley and wire rope.
5	Exercise to design roller bearings.
6	Exercise to design journal bearing.
7	Exercise to design thin and thick pressure vessels.
8	Prepare drawing or model of designed pressure vessel.

Semester 7

(1)

a. **Course Name:** Advanced Manufacturing System
b. **Course Code:** 303113401
c. **Prerequisite:** Basic Knowledge of Manufacturing Process
d. **Rationale:** To expose the students to the basics of NC, CNC, DNC machines. To make them understand the concept of writing the manual part program on CNC milling and lathe machines. To introduce the students to the different components of Computer Integrated Manufacturing systems.
e. **Course Learning Objective:**

CLOBJ1	Understand the principles of advanced manufacturing processes and technologies.
CLOBJ2	Develop proficiency in implementing automation and robotics in manufacturing systems.
CLOBJ3	Master advanced materials and their applications in manufacturing.
CLOBJ4	Acquire skills in optimizing production processes through data analytics and smart manufacturing technologies.

f. **Course Learning Outcomes:**

CLO 1	Students will classify different components using different techniques of group technology.
CLO 2	Students will prepare Process planning for different components.
CLO 3	Students will select layouts of FMS for industrial applications.
CLO 4	Students will describe Robot for preliminary industrial applications like pick and place.

CLO 5	Design a safe and effective method of investigating a systemidentification problem in the laboratory.
CLO 6	Student will identify application of PPC, JIT, MRP-I, MRP-II, and Expert system to CAM.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	4	5	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Computer Aided Manufacturing** CAM Concepts, Objectives & scope, Nature & Type of manufacturing system, Evolution, Benefits of CAM, Role of management in CAM, Concepts of Computer Integrated Manufacturing, Impact of CIM on personnel, Role of manufacturing engineers, CIM Wheel to understand basic functions.	10	5
2	**NC/CNC Machine Tools: NC and CNC Technology** Types, Classification, Specification and components, Construction Details, Controllers, Sensors and Actuators, CNC hardware: Re circulating ball screw, anti-friction slides, step/servo motors. Axis designation, NC/CNC tooling. Fundamentals of Part programming, Types of formats, Part Programming for drilling, lathe and milling machine operations, subroutines, do loops, canned Cycles, parametric sub routines. Introduction of APT Language.	45	18
3	**Group Technology and CAPP** Introduction, part families, part classification and coding systems: OPITZ, PFA, FFA, Cell design, rank order clustering, composite part concepts, Benefits of group technology. Approaches to Process Planning, Different CAPP system, application and benefits.	13	7
4	**Flexible Manufacturing System** Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS lay out and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles, Cellular manufacturing, Tool Management, Tool supply system, Tool Monitoring System, Flexible Fixturing, Flexible Assembly Systems.	16	8
5	**Integrated Production Management System** Introduction, PPC fundamentals, Just in Time philosophy: JIT & GT applied to FMS, concepts of Expert System in Manufacturing and Management Information System. Introduction of CAQC systems.	16	7
	Total	100	45

i. Text Book and Reference Book:

1. Computer Aided Manufacturing by Tien Chien Chang.
2. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover.
3. Flexible Manufacturing Cells and System by William. W. Luggen Hall.
4. Computer Numerical Control by P. Radhakrishnan.
5. Computer Aided Manufacturing by Rao, Tewari, Kundra.
6. CAD/CAM, Principles and Applications by P N Rao.

j. Experiment List:

Sr. No.	Experiment List
1	Study of Computer Integrated System.
2	CNC part Programming: Milling.
3	CNC part Programming: Milling Canned Cycle.
4	CNC part Programming: Lathe
5	CNC part Programming: Lathe Canned Cycle.
6	Problems on GT and Industrial case problems on coding
7	Problems on CAPP and Industrial case problems.
8	Study of Flexible Manufacturing system.
9	Study about MRP-I, MRP-II.
10	Study of Expert System in Manufacturing and MIS.

(2)

a. **Course Name:** Autotronics
b. **Course Code:** 303113403
c. **Prerequisite:** Basic Knowledge of Automobile Engineering Electronics Engineering.
d. **Rationale:** Autotronics, the fusion of automotive technology and electronics, plays a pivotal role in optimizing vehicle performance and safety through intelligent electronic control systems.
e. **Course Learning Objective:**

CLOBJ1	Understand the fundamental principles of automotive electronics, including sensors, actuators, and control systems.
CLOBJ2	Develop proficiency in diagnosing and troubleshooting electronic systems in modern vehicles.
CLOBJ3	Master the design and implementation of electronic circuits for automotive applications.
CLOBJ4	Acquire hands-on skills in using diagnostic tools and software for autotronics systems.
CLOBJ5	Demonstrate the ability to integrate and optimize autotronics components to enhance vehicle performance and efficiency.

f. **Course Learning Outcomes:**

CLO 1	Understand automotive electronics, including sensors, actuators, and control systems.
CLO 2	Master diagnostic and troubleshooting skills for resolving electronic issues in modern vehicles.
CLO 3	Design and implement effective electronic circuits for automotive applications.
CLO 4	Gain hands-on experience with diagnostic tools and software for practical autotronics system maintenance.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**30**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction:** Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.	15	6
2	**Ignition and Injection System:** Ignition systems: Ignition fundamentals - Electronic ignition systems – Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fueling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.	25	12
3	**Sensor and Actuators:** Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.	20	8
4	**Engine Control Systems:** Control modes for fuel control-engine control subsystems. ignition control methodologies. different ECU.s used in the engine management. block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard. diagnostics systems in modern automobiles.	25	12
5	**Chassis and Safety Systems:** Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars	15	7
	Total	100	60

i. Text Book and Reference Book:

1. "Automotive Electronics: Principles and Practices" by William H. Crouse and Donald L. Anglin.
2. "Automotive Mechatronics: Automotive Networking, Driving Stability Systems, Electronics" by Konrad Reif.
3. “Mechatronics: Principles and Applications" by Godfrey C. Onwubolu.
4. "Automotive Electronic Systems" by Trevor Mellard.

j. Experiment List:

Sr. No.	Experiment List
1	Introduction to Autotronics Components.
2	Engine Control Unit (ECU) Interfacing.
3	Automotive Sensor Calibration.
4	Electronic Fuel Injection (EFI) System Analysis.
5	ABS (Anti-lock Braking System) Operation.
6	CAN Bus Communication.
7	Vehicle Security System Implementation.
8	Automatic Transmission Control System.
9	Hybrid/Electric Vehicle Simulation.
10	Adaptive Cruise Control System Design.

(3)

a. **Course Name:** Summer Internship
b. **Course Code:** 303103406
c. **Prerequisite:** Current technological developments relevant to the subject area of training.
d. **Rationale:** The rise in global competition has prompted organizations to devise strategies to have a talented and innovative workforce to gain a competitive edge. Developing an internship policy is an impactful strategy for creating a future talent pool for the industry. The Internship program not only helps fresh pass-outs in gaining professional know-how but also benefits, corporate on fresh perspectives on business issues and even discovering future business leaders.
e. **Course Learning Objective:**

CLOBJ1	Learn to use mechatronics tools to solve real-world engineering problems.
CLOBJ2	Work well with others in diverse teams on mechatronics projects to improve teamwork skills.
CLOBJ3	Understand how mechatronic systems work by being involved in their development from start to finish.
CLOBJ4	Solve practical problems in mechatronics using what you've learned in your studies.
CLOBJ5	Build connections with professionals in mechatronics through networking and hands-on project collaboration.

f. **Course Learning Outcomes:**

CLO 1	Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
CLO 2	Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
CLO 3	Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
CLO 4	Expose students to the engineer's responsibilities and ethics
CLO 5	Expose the students to future employers

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
-	-	-	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

(4)

a. **Course Name:** Project-I
b. **Course Code:** 303103408
c. **Prerequisite:** The students are required to identify their problem and they are required to follow all the rules and instructions issued by department, for safety and other requirements.
d. **Rationale:** To understand the basic theory, study of the particular Systems/Services/Processes in the context of the abstract problem area/s. After understanding the student will analyze the information, prepare list of probable requirements, the questions if any, the probable forecasting of hurdles which might be observed in future and finding the way outs.
e. **Course Learning Objective:**

CLOBJ1	Understand how mechanical, electronic, and computer engineering work together.
CLOBJ2	Get hands-on experience in choosing and using sensors and actuators for practical applications.
CLOBJ3	Gain skills in creating and implementing control systems that are stable, responsive, and reliable.
CLOBJ4	Develop the ability to program microcontrollers and embedded systems for seamless integration in mechatronic projects.
CLOBJ5	Improve teamwork and project management skills by actively participating in planning, executing, and evaluating mechatronics projects with others.

f. **Course Learning Outcomes:**

CLO 1	Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
CLO 2	Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
CLO 3	Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
CLO 4	Expose students to the engineer's responsibilities and ethics
CLO 5	Expose the students to future employers

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
-	-	14	6	-	-	100	-	100	200

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

(5)

a. **Course Name:** MEMS and Nanotechnology
b. **Course Code:** 303113431
c. **Prerequisite:** Basic knowledge regarding materials is required.
d. **Rationale:** The subject is used for understanding the concepts and techniques related to design and manufacturing of MEMS components. It will be useful to attain a broad range of the knowledge required to flourish in the rapidly developing field of Nanotechnology.
e. **Course Learning Objective:**

CLOBJ1	Learn how Microelectromechanical Systems (MEMS) and Nanotechnology work, including how they are made.
CLOBJ2	Discover how to design and improve MEMS devices for applications like sensors and actuators.
CLOBJ3	Explore how MEMS and Nanotechnology are used in different areas of engineering, such as electronics, healthcare, and communication.
CLOBJ4	Master the skills to test and analyze MEMS and Nanotechnology devices through hands-on experiments.
CLOBJ5	Understand the ethical and social aspects of MEMS and Nanotechnology, considering their impact on the environment and safety.

f. **Course Learning Outcomes:**

CLO 1	To attain a broad range of the knowledge required to flourish in the rapidly developing field of MEMS and Nanotechnology.
CLO 2	Facilitate the application of basic physical laws, chemical laws, dynamic behavior as well as steady state performance to design and synthesize MEMS and Microsystems.
CLO 3	Acquaint with applications of mems fabrication techniques and nanotechnology to solve the problems encountered at a macro level.
CLO 4	Gain Proficiency in modeling, simulating and evaluating MEMS and Microsystems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**2**	**4**	**20**	**20**	**20**	**60**	**20**	**150**

L- Lectures; **T**- Tutorial; **P**- Practical; **C**- Credit; **MSE**- Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE**- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to MEMS and Micro Systems** MEMS and Microsystems, Typical MEMS and Microsystem Products, Evolution of Microfabrication, Microsystems and Microelectronics, The Multidisciplinary Nature of Microsystem, Design and Manufacture, Microsystems and Miniaturization, Applications of Microsystems in the Automotive Industry, Applications of Microsystems in Other Industries	18	7
2	**Working Principles of Microsystems** Introduction, Microsensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers	7	3
3	**Engineering Mechanics for Microsystem Design** Introduction, Static bending of thin plates, Mechanical Vibration, Thermo-mechanics, Fracture mechanics, Thin Film mechanics, Use of FEA in MEMS structures	12	6
4	**Scaling Laws in Miniaturization** Introduction to Scaling, Scaling in Geometry, Scaling in Rigid-Body Dynamics, The Trimmer Force Scaling Vector, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics.	5	2
5	**Microsystem Materials** Molecular Theory and Intermolecular Forces – Silicon Piezo Resistors– Electrochemistry – Substrates and Wafers – Silicon Compounds – Polymers – Packaging Materials	12	6
6	**Microsystem Fabrication Process** Photolithography – Ion Implantation – Diffusion –Oxidation – Chemical Vapor Deposition – Etching – Applications of MEMS in Automatic-Telecom and Other Industries.	22	10
7	**Nanotechnology Basics** Nano building Blocks – Atoms and Molecular Structure –Molecular Recognition – Tools For Measuring Nanostructures – Electron Microscopy – Spectroscopy – Molecular Synthesis and Polymerization – Encapsulation.	7	3
8	**Science of Nano Materials** Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top-down processes – bottom-up process.	10	5
9	**Applications of Nanotechnology In Medicines** Nano biosensors – Electronic Nose – Photo Dynamic Therapy – Molecular Motors – Protein Engineering	7	3
	Total	100	45

i. Text Book and Reference Book:

1. MEMS & Microsystems Design & Manufacture by Tai, Ran Hsu.
2. Nanotechnology by Richard Booker, Earl Boysen.
3. Nanotechnology by Mart Ratner, Daniel Ratner.
4. Introduction to nanotechnology by Charles P. Poole.
5. Nano Technology by Norio Taniguchi.
6. The MEMS Hand book by Mohamed Gad-el-Hak.

j. Experiment List:

Sr. No.	Experiment List
1	Introduction to MEMS & Microsystems.
2	Mechanics of MEMS.
3	Dynamics of MEMS.
4	Fabrications processes for MEMS.
5	To Perform Multiphysics Analysis of a Thermal Actuator -I.
6	To Perform Multiphysics Analysis of a Thermal Actuator -II.
7	Design and Analysis of MEMS Pressure Sensor-I
8	Design and Analysis of MEMS Pressure Sensor-II.
9	MEMS simulations using COMSOL.
10	To study basics of Nanotechnology.

Semester 8

(1)

a. **Course Name:** Mechatronics Software Lab
b. **Course Code:** 203113454
c. **Prerequisite:** Basic knowledge of engineering drawing & design is required
d. **Rationale:** To introduce the students to the basic applications of software in design & analysis of mechanical & electronics components used in automation.
e. **Course Learning Objective:**

CLOBJ1	Design and implement mechatronic control systems using software tools and programming languages.
CLOBJ2	Develop proficiency in programming microcontrollers for real-time control in mechatronic applications.
CLOBJ3	Integrate sensors and actuators into mechatronic systems, ensuring seamless communication and functionality through software.
CLOBJ4	Analyze and optimize the performance of mechatronic systems by employing software-based modeling and simulation techniques.
CLOBJ5	Apply software-based troubleshooting and debugging skills to diagnose and resolve issues in mechatronic systems.

f. **Course Learning Outcomes:**

CLO 1	Learn to create and control robots and automated systems using software tools and programming languages.
CLO 2	Gain hands-on experience in programming tiny computers to make things move and respond in real-time.
CLO 3	Understand how to connect and make different parts of machines work together smoothly using software.
CLO 4	Figure out how to fix problems in machines by using computer programs to find and solve issues.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
-	**-**	**4**	**1**	**-**	**-**	**50**	**-**	**50**	**100**

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation**, CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Sr. No.	Experiment List
1	Introduction to Modelling Software Creo
2	To prepare different solid models by using basic tools in Creo parametric software.
3	To prepare different solid models by using advance tools in Creo parametric software.
4	To prepare different solid models by using Engineering & Editing tools using Creo parametric software.
5	To prepare Assembly model by using Creo Parametric software.
6	To prepare drawing sheet by using Creo Parametric Software.
7	To prepare different Surface models by using Creo Parametric Software.
8	To utilize other drawing options in Creo Parametric Software.
9	To generate different sheet metal component by using Creo Parametric Software.
10	Student Project (Prepare solid model of industrial parts and its assembly using parametric modelling software).

(2)

a. **Course Name:** Project-IV
b. **Course Code:** 303113456
c. **Prerequisite:** The students are required to identify their problem and they are required to follow all the rules and instructions issued by department, for safety and other requirements.
d. **Rationale:** To understand the basic theory, study of the particular Systems/Services/Processes in the context of the abstract problem area/s. After understanding the student will analyze the information, prepare list of probable requirements, the questions if any, the probable forecasting of hurdles which might be observed in future and finding the way outs.
e. **Course Learning Objective:**

CLOBJ1	Learn how to design and model mechatronic systems using computer programs.
CLOBJ2	Use advanced control methods to make mechatronic devices work better in different situations.
CLOBJ3	Combine sensors and actuators to create strong and responsive mechatronic systems.
CLOBJ4	Figure out and fix problems in complicated mechatronic projects using a step-by-step approach.
CLOBJ5	Work well in a team to plan, do, and show a complete mechatronics project, using skills from different areas.

f. **Course Learning Outcomes:**

CLO 1	Understand how to use computer programs for designing mechatronic systems.
CLO 2	Improve mechatronic devices by applying advanced control methods.
CLO 3	Build responsive systems by combining sensors and actuators.
CLO 4	Solve problems step by step in complex mechatronic projects.
CLO 5	Collaborate effectively in a team to plan, execute, and showcase mechatronics projects using diverse skills.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**16**	**6**	**-**	**-**	**100**	**-**	**100**	**200**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-

Continuous Evaluation, **ESE-** End Semester Examination

(3)

a. **Course Name:** Internet of Things

b. **Course Code:** 303113481

c. **Prerequisite:** Fundamentals of Embedded system, Wireless Communication, internet technology. Basic knowledge of electronic components and programming skills for lab.

d. **Rationale:** The explosive growth of the "Internet of Things" is changing our world. IoT components are allowing people to innovate new designs and products at home. In this course students will learn the importance of IoT in society, the current components of typical IoT devices and trends for the future. This course will make students understand Hardware and software component for IoT. This course is also covering components of the networking and how to connect devices with internet. For lab, it requires that they should know very well about logical control action fundamentals.

e. **Course Learning Objective:**

CLOBJ1	Learn the basics of IoT, including sensors, communication, and data analysis.
CLOBJ2	Develop skills to create and set up IoT solutions with sensors, actuators, and communication tools.
CLOBJ3	Understand and implement security measures to protect IoT devices and data.
CLOBJ4	Use advanced data analysis to extract useful information from IoT-generated data.
CLOBJ5	Design and optimize IoT systems for different purposes, considering scalability and compatibility.

f. **Course Learning Outcomes:**

CLO 1	Define the term "Internet of Things".
CLO 2	State the technological trends which have led to "Internet of Things"
CLO 3	Describe the impact of "Internet of Things" on society.
CLO 4	Describe the interactions of Things with the physical world.
CLO 5	Describe the interaction between software and hardware in an "Internet of Things" device.
CLO 6	Understand the application of "Internet of Things".

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, CE- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction to IoT:** The Internet of Things Today, Internet of Things Vision, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technology- Embedded System, Wireless Sensor Networks, Communication Protocols, Big Data analysis, Cloud Computing, IoT Devices, IoT Devices vs. Computers, Societal Benefits of IoT, Risks, Privacy, and Security.	15	7
2	**IoT and M2M (Machine-to-Machine):** Introduction, Machine-to-Machine communication, Difference between IoT and M2M, Software Defined Networking and Network Function Virtualization, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.	15	7
3	**IoT Architecture:** Introduction, Architecture Reference Model, IoT Design Methodology- Purpose and Requirement Specification, Process Specification, Domain Model Specification, Functional View, Information View, Deployment and Operational View, Device and Component Integration, Other Relevant architectural views, Application Development, Protocol of IoT.	15	7
4	**Hardware and Software:** Arduino Board: Arduino Platform, Arduino IDE, Compiling Code, Arduino Shields, Arduino Basic Setup & Interface. Raspberry Pi: About the board, Raspberry Pi Interfaces, Serial, SPI, Programming Raspberry Pi, Controlling LED with Raspberry pi.	20	9
5	**IoT Applications:** Introduction, IoT applications for industry: Future Factory Concepts, Smart Objects, Smart Applications, Opinions on IoT Application and Value for Industry, Home Automation, Environment, Energy, Health and Lifestyle, Retail & Logistics, Agriculture, Case Studies: Smart Cities.	20	8

6	**Internet of Things Privacy, Security and Governance:** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data- Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities.	**15**	**7**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. "Internet of Things (A Hands-on-Approach)" by Vijay Madisetti and Arshdeep Bahga.
2. Arduino Cookbook by Michael Margolis.
3. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", by Francis DaCosta.
4. Getting started with Internet of Things by Cunopfister.
5. The internet of things, Enabling Technologies, platform and use cases by Pethuru raj and anupama c. rajann.

j. Experiment List:

Sr. No.	**Experiment List**
1	Study basic Architecture of internet of things.
2	Demonstrations of Different IOT devices.
3	Introduction to Arduino board (NODE MCU)
4	Interfacing of Arduino board with LED and Switches.
5	Interfacing of Arduino with Sensor like IR sensor.
6	Interfacing of Arduino with Temperature sensor & Humidity sensor (DHT 22).
7	Interfacing of Arduino with Motors.
8	Connect Raspberry Pi with your existing system components.
9	Introduction and working of Raspberry Pi.
10	Interfacing Raspberry Pi board with LED.
11	Interfacing Raspberry Pi Board with, Light sensor (LDR).
12	Interfacing Raspberry Pi Board with Switch and other Devices.
13	Interfacing of Raspberry Pi Board with, Temperature Sensor, Ultrasonic Sensor.
14	Case Study of IoT Applications.

15	OEP

(4)

a. **Course Name:** Vision System and Image Processing
b. **Course Code:** 303122481, 303122482
c. **Prerequisite:** Prerequisites for a vision system and image processing course include a solid understanding of mathematics, programming skills (Python/MATLAB), and basic knowledge in digital signal processing and computer science fundamentals.
d. **Rationale:** The rationale behind vision system and image processing lies in harnessing computational techniques to extract, analyze, and interpret information from visual data, enabling applications such as pattern recognition, object detection, and computer vision systems, with wide-ranging implications in fields like medical imaging, robotics, and automation.
e. **Course Learning Objective:**

CLOBJ 1	Develop proficiency in various image acquisition techniques and preprocessing methods.
CLOBJ 2	Explore and apply image enhancement and restoration techniques to improve image quality.
CLOBJ 3	Learn feature extraction and representation methods essential for effective pattern recognition.
CLOBJ 4	Acquire skills in image segmentation and object recognition algorithms.
CLOBJ 5	Understand the practical applications of image analysis and computer vision in diverse fields.

f. **Course Learning Outcomes:**

CLO 1	Understand the fundamental principles of image processing and computer vision.
CLO 2	Develop proficiency in image acquisition techniques and preprocessing methods.
CLO 3	Explore various image enhancement and restoration techniques.
CLO 4	Learn feature extraction and representation methods for pattern recognition.
CLO 5	Gain skills in image segmentation and object recognition algorithms.
CLO 6	Understand the basics of image analysis and computer vision applications.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	2	4	20	20	20	60	30	150

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Introduction:** Image Processing, Computer Vision and Computer Graphics, what is Computer Vision- Low- level, Mid-level, High-level, Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality	10	5
2	**Image Formation Models:** Monocular imaging system, Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading, Photometrictereo, Depth from Defocus, Construction of 3D model from images.	15	5
3	**Image Processing and Feature Extraction** Image pre-processing, Image representations (continuous and discrete), Edge detection	15	4
4	**Motion Estimation:** Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion	10	4
5	**Shape Representation and Segmentation** Contour based representation, Region based representation, Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Multiresolution analysis	15	4
6	**Object Recognition** Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition	10	7

7	**Image Understanding** Pattern recognition methods, HMM, GMM and EM.	**10**	**8**
8	**Applications** Photo album–Face detection–Face recognition–Eigenfaces–Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters –Chamfer matching, tracking, and occlusion – combining views from cameras–human gait analysis Application: In-vehicle vision system: locating roadway–road markings identifying road signs–locating pedestrians	**15**	**8**
	Total	**100**	**45**

i. Text Book and Reference Book:

1. Computer Vision - A modern approach By D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.
2. Digital Image Processing by R. C. Gonzalez, R. E. Woods, Addison Wesley Longman, Inc., 1992
3. Computer Vision: Algorithms and Applications (CVAA) By Richard Szeliski, Springer, 2010
4. Computer & Machine Vision by E. R. Davies, Fourth Edition, Academic Press, 2012.
5. Computer Vision: Models, Learning, and Inference by Simon J. D. Prince, Cambridge University Press, 2012.

j. Experiment List:

Sr. NO.	Experiment List
1	Implement image pre- processing and Edge detection using MATLAB.
2	Implement camera calibration methods using MATLAB.
3	Implement Projection using MATLAB.
4	Determine depth map from Stereo pair using MATLAB
5	Construct 3D model from Stereo pair using MATLAB.
6	Implement Segmentation methods using MATLAB. using vision, touch, sound etc.
7	Construct 3D model from defocus image using MATLAB.
8	Implement optical flow method using MATLAB.
9	Implement object detection and tracking from video using MATLAB. Need for service robot.