



Four-Year Undergraduate Programme

Bachelor of Technology

Robotics and Automation Engineering

Faculty of Engineering & Technology

Parul University

Vadodara, Gujarat, India

Faculty of Engineering & Technology
Bachelor of Technology in Robotics and Automation Engineering

1. Vision of the Department

To develop robotics and automation engineers with systems and interdisciplinary approach keeping pace with innovative technologies.

2. Mission of the Department

M1: To provide quality education through effective teaching learning process to meet the industry requirement.

M2: To inculcate problem solving and lifelong learning skills through project based approach in collaboration with industries.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Tech. Robotics and Automation 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, 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, 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	Design of Robotics System	To demonstrate proficiency in designing robotic systems with integrated sensors and control algorithms.
PSO 2	Software skill	To consider ethical and societal implications in the development and deployment of robotics and automation technologies.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	22
Semester-2	20
Semester-3	24
Semester-4	22
Semester-5	25
Semester-6	24
Semester-7	16
Semester-8	14
Total Credits:	167

Category wise Credit distribution of the programme	
Category	Credit
Major Core	78
Minor Stream	32
Multidisciplinary	23
Ability Enhancement Course	9
Skill Enhancement Courses	5
Value added Courses	2
Summer Internship	2
Research Project/Dissertation	16
Total Credits:	167

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303105102	Programming for Problem Solving	4	3	2	0
2	303106101	Basic Electrical Engineering	4	3	2	0
3	303109101	Engineering Graphics	4	2	4	0
4	303191101	Mathematics-I	4	4	0	0
5	303193103	Communication Skills	2	0	0	2
6	303192102	Engineering Physics-II	4	3	2	0
Total			22	15	10	2

Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
7	303100101	Workshop	2	0	4	0
8	303104105	Environmental Science	0	1	0	0
9	303104155	Mechanics of Solids	4	3	2	0
10	303107151	Basic Electronics	4	3	2	0
11	303109102	Elements of Mechanical Engineering	4	3	2	0
12	303191151	Mathematics-II	4	4	0	0
13	303193152	Advanced Communication & Technical Writing	2	0	0	2
Total			20	14	10	2
Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
14	303111203	Control Theory	3	3	0	0
15	303111204	Control Theory Lab	1	0	2	0
16	303113201	Analog and Digital Electronics	4	4	0	0
17	303113202	Analog and Digital Electronics Lab	1	0	2	0
18	303113203	Electrical Machines	3	3	0	0
19	303113204	Electrical Machines Lab	1	0	2	0
20	303122201	Network Analysis and Synthesis	3	3	0	0
21	303122202	Network Analysis and Synthesis Lab	1	0	2	0
22	303122203	Material Engineering	3	3	0	0
23	303122204	Material Engineering Lab	1	0	2	0
24	303106213	Product Realisation	1	0	2	0
25	303193203	Professional Communication Skills	2	0	0	2
Total			24	16	12	2
Semester 4						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
26	303113255	Basics of Signal & Systems	3	3	0	0
27	303113256	Basics of Signal & Systems Lab	1	0	2	0

28	303122251	Fundamental of Robotics and Robot Kinematics	4	4	0	0
29	303122252	Fundamental of Robotics and Robot Kinematics Lab	1	0	2	0
30	303122253	Sensors and Transducers	3	3	0	0
31	303122254	Sensors and Transducers Lab	1	0	2	0
32	303122255	Manufacturing Technology	3	3	0	0
33	303122256	Manufacturing Technology Lab	1	0	2	0
34	303122257	Communication Protocols for Robotics	3	3	0	0
35	303122258	Communication Protocols for Robotics Lab	1	0	2	0
36	303193252	Professional Grooming & Personality Development	1	0	0	1
Total			22	16	10	1

Semester 5

Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
37	303122301	Python Programming	3	3	0	0
38	303122302	Python Programming Lab	1	0	2	0
39	303122303	Computer Integrated Manufacturing	3	3	0	0
40	303122304	Computer Integrated Manufacturing Lab	1	0	2	0
41	303122305	Microcontrollers and Interfacing for Robotics	3	3	0	0
42	303122306	Microcontrollers and Interfacing for Robotics Lab	1	0	2	0
43	303122307	Robot Dynamics and Manipulator Design	3	3	0	0
44	303122308	Robot Dynamics and Manipulator Design Lab	1	0	2	0
45	303106309	Summer Internship - I	2	0	0	0
46	303193304	Professionalism & Corporate Ethics	1	0	0	1
47		Open Elective 01	2	2	0	0
48		PEC 01-LAB	1	0	2	0
49		PEC 01	3	3	0	0
Total			25	17	10	1

PEC 01						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122331	Computer Aided Design and Analysis	3	3	0	0
2	303122333	Operational Research	3	3	0	0
3	303122335	Nonconventional Manufacturing Techniques	3	3	0	0
PEC 01-LAB						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122332	Computer Aided Design and Analysis Lab	1	0	2	0
2	303122334	Operational Research	1	0	2	0
3	303122336	Nonconventional Manufacturing Techniques	1	0	2	0
Open Elective 01						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303101346	Basic Aircraft Science	2	2	0	0
2	303104311	Disaster Preparedness and Planning	2	2	0	0
3	303105304	Cyber Security	2	2	0	0
4	303107346	Fundamentals of Communication Engineering	2	2	0	0
5	303105305	Internet of Things	2	2	0	0
6	303109346	Renewable Energy Sources	2	2	0	0
Semester 6						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
50	303113351	Industrial Automation	3	3	0	0
51	303113352	Industrial Automation Lab	1	0	2	0
52	303122351	Hydraulic and Pneumatic Systems	3	3	0	0
53	303122352	Hydraulic and Pneumatic Systems Lab	1	0	2	0
54	303122353	Power Electronics and Drives	3	3	0	0
55	303122354	Power Electronics and Drives Lab	1	0	2	0

56	303122355	Micro and Smart Systems Technology	3	3	0	0
57	303122356	Micro and Smart Systems Technology Lab	1	0	2	0
58	303193353	Employability Skills	1	0	0	1
59	303122358	Minor Project	1	0	0	0
60		Open Elective 02	2	2	0	0
60		PEC 02	3	3	0	0
61		PEC 02-LAB	1	0	2	0
Total			24	17	10	1
PEC 02						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122381	Real Time Embedded Systems	3	3	0	0
2	303122383	VLSI Design	3	3	0	0
3	303122385	Wireless Communication	3	3	0	0
PEC 02-LAB						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122382	Real Time Embedded Systems Lab	1	0	2	0
2	303122384	VLSI Design Lab	1	0	2	0
3	303122386	Wireless Communication Lab	1	0	2	0
Open Elective 02						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303100351	Life Science	2	2	0	0
2	303100352	Biology for Engineers	2	2	0	0
3	303100353	Engineering Geology	2	2	0	0
4	303100354	Landscape Planning and Design	2	2	0	0
5	303100355	Fundamentals of Management	2	2	0	0
6	303100356	Corporate Social Responsibility	2	2	0	0
7	303100357	Innovation and Entrepreneurship	2	2	0	0
8	303100359	Cyber Law & Ethics	2	2	0	0
Semester 7						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
62	303122401	Field and Service Robots	3	2	0	0

63	303122402	Field and Service Robots Lab	1	0	2	0
64	303122404	Summer Internship - II	2	0	0	0
65	303122406	Project - I	6	0	12	0
66		PEC 03	3	3	0	0
67		PEC 03-LAB	1	0	2	0
Total			16	5	16	0
PEC 03						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122431	Internet of Things	3	3	0	0
2	303122433	Digital Signal Processing and Applications	3	3	0	0
3	303122435	Industrial Networking	3	3	0	0
PEC 03-LAB						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122432	Internet of Things Lab	1	0	2	0
2	303122434	Digital Signal Processing and Applications Lab	1	0	2	0
3	303122436	Industrial Networking Lab	1	0	2	0
Semester 8						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
68	303122451	Artificial Intelligence For Robotics	3	3	0	0
69	303122452	Artificial Intelligence For Robotics Lab	1	0	2	0
70	303122454	Project-II	6	0	12	0
71		PEC 04	3	3	0	0
72		PEC 04-LAB	1	0	2	0
Total			14	6	16	0
PEC 04						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122481	Vision Systems and Image Processing	3	3	0	0
2	303122483	Optimization in Engineering Design	3	3	0	0

3	303122485	Advanced Control System	3	3	0	0
PEC 04-LAB						
Sr. No.	Subject Code	Subject Name	Credit	Lec	Lab	Tut
1	303122482	Vision Systems and Image Processing	1	0	2	0
2	303122484	Optimization in Engineering Design	1	0	2	0
3	303122486	Advanced Control System	1	0	2	0
Total			167			

8. 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.	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	3%	1
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%	1
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%	3
4	Operators and Expression: Introduction to Operators and its types, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associativity.	9%	4
5	Management Input and Output Operators: Introduction, reading a character, writing a character, formatted input, formatted output.	5%	3
6	Control structure in C: Decision Making & branching: Decision making with If & Else statements, If.. Else statements (Nested ... Ladder), The Switch & goto statements, The ternary (?:) Operator Looping: The while statement, The break statement & The Do.. While loop, The FOR loop, Jump within loops – Programs	15%	7
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%	4

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%	4
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%	4
11	Pointers: Basics of pointers, pointer to pointer, pointer and array, Pointer to array, array of pointers, functions returning a pointer	10%	4
12	Dynamic memory allocation: Introduction to Dynamic memory allocation, malloc (), calloc (), free (), realloc ()	5%	3
13	File Management in C: Introduction to file management and its functions	5%	3
	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 Publications

j. Experiment List:

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. $153=1^3+5^3+3^3=153$
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 a 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 fgetc()

(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,	33%	15

	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.		
3	Transformers Magnetic effect of an electric current, right-hand thumb rule, Concept of m.m.f, flux, flux density, reluctance, 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.	20%	9
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, Pub. Year 2009
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:** 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					
L	T	P	C	Internal Evaluation			ESE		Total
				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, Involute 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	10%	3

	inclined to one of the Reference Plane and inclined to two Reference Planes.		
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 Orthographic Views – Side and Front, Offset Cutting views	15%	5
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.

(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 comprehensive understanding of definite and improper integrals, including the application of integration techniques to find areas and volumes in both Cartesian and Polar coordinates.
CLOBJ 2	Utilize differential equations to model and solve practical scenarios, demonstrating proficiency in various solution techniques.
CLOBJ 3	Analyse the convergence and divergence of sequences and series, employing tests such as the Alternating Series Test and Ratio Test
CLOBJ 4	Analyse matrix operations and determinants, exploring their properties and applications in solving systems of linear equations.
CLOBJ 5	Apply Fourier series for representing periodic functions, verifying Dirichlet's conditions.
CLOBJ 6	Solve optimization problems using multivariable calculus concepts, such as Lagrange's multiplier.

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 analyze 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.
CLO 5	Clearly and effectively communicate mathematical ideas, solutions, and reasoning, both in written and oral formats, demonstrating effective communication skills.

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	UNIT 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	UNIT 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	UNIT 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	UNIT 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 Conditional convergence, Ratio test, Cauchy's Root Test, Power series, Taylor's and Maclaurin's series.	17%	10

5	UNIT 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	UNIT 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 (Text Book) 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 (Text Book) By Howard Anton, Chris Rorres | Willy India Edition | 9th Edition
- 5 Advanced Engineering Mathematics (Text Book) By Erwin Kreyszig | Willey India Education
- 6 A textbook of Engineering Mathematics By N.P. Bali and Manish Goyal | Laxmi Publications

(5)

- a. Course Name:** Communication Skill
- 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 listening skills, including the ability to comprehend, interpret, and respond appropriately to spoken messages.

CLOBJ 4	Students will exhibit proficiency in written communication, crafting clear, concise, and well-organized messages across various formats (emails, reports, memos, etc.).
CLOBJ 5	Students will develop and deliver professional presentations, incorporating effective visual aids, engaging content, and confident delivery.
CLOBJ 6	Students will understand and utilize various digital communication tools and platforms, demonstrating proficiency in virtual communication.

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 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	Topic	Weightage	Teaching Hrs.
1	Crazy Scientist: The students will be taught the importance of invention and innovation using some examples that changed the world the way 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 play 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 to enact 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 with them. - 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 on reading 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 on simple topics. - To change the average speakers in the class to some of the best 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	10%	4

	writing skills.		
	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

(6)

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 12th science 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 Schrödinger's equations and the physical significance of wave functions..
CLOBJ 2	Apply the Schrödinger equation to analyze particles in one-dimensional potential boxes, emphasizing practical implications and tunneling 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 analyzing physical, thermal, electrical, optical, and magnetic properties.
CLOBJ 5	Gain expertise in laser principles, types, and applications, as well as fiber 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 Hrs.
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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 Tunneling 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. Reference 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:** Zeal to learn the subject.
- 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.
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g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	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 | TMH
 2. Electronic Devices by Thomas L. Floyd | Pearson, Prentice Hall "Linear Systems and Signals" by B.P. Lathi.
 3. Electronic Devices and Circuits by David A. Bell | Oxford Publication
 4. Electronic Devices and Circuits by Jacob Millman and Halkias | Tata McGraw Hill Publication New Delhi.
 5. Shop Theory by Anderson James & Earl E. Tatro | Macmillan/McGraw-Hill School.
 6. Workshop Technology by Bava H. S. | Tata McGraw Hill Publishing Co. Ltd.
 7. Elements of Workshop Technology Vol. I By Hajra Chaudhary S.K. | Asia Publishing House.
 8. Workshop Technology by Chapman, W.A.J. ELBS Low Price Text | Edward Donald Pub. Ltd.
 9. Basic Machine Shop Practice Vol. I & II By Tejawani, V.K. | Tata McGraw Hill Pub. Co.
 10. Workshop Technology Vol. I & II By Arora, B.D. | Satya Prakashan, New Delhi"
- 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).

Exp. No.	Name of the Experiment
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.
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	0	0	0	-	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%	4
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	20%	3
3	POPULATION GROWTH, GLOBAL ENVIRONMENTAL CHALLENGES & LATEST	25%	4

	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.		
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. 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	30%	4

	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	100	15

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, Tata McGraw Hill
3. "Environmental Studies" By Anindita Basak, Dring Kindersley (India) Pvt. Ltd Pearson
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.
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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 of particle 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%	7
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	15%	7

	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.		
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 Bending Moment, 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%	11
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 and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio.	25%	11
	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.

j. Experiment List:

Exp. No.	Name of the Experiment
1	Equilibrium of Coplanar-Concurrent force system (Law of Parallelogram of forces) by analytical method
2	Equilibrium of Coplanar-Concurrent force system (Law of Parallelogram of

Exp. No.	Name of the Experiment
	forces) by graphical method
3	Equilibrium of Coplanar-Concurrent force system (Law of Polygon of forces) by analytical method
4	Equilibrium of Coplanar-Concurrent force system (Law of Polygon of forces) by graphical method
5	Equilibrium of Coplanar non-concurrent forces (theory)
6	Equilibrium of Coplanar non-concurrent forces (performance)
7	Theorem Equilibrium of parallel force system - Simply Supported Beam
8	Verification of principle of the moment: Bell crank lever
9	Determination Coefficient of static friction (theory)
10	Determination Coefficient of static friction (performance)
11	Brinell Hardness test
12	Izod impact test
13	Compression test on timber
14	Transverse test on Timber
15	Tensile test on mild steel

(4)

a. Course Name: Basic Electronics

b. Course Code: 303107151/303107152

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

d. Rationale: The course provides introductory treatment of the field of Basic of Electronics to the students of various branches of engineering.

e. Course Learning Objective:

CLOBJ 1	Explain the fundamental concepts of electronic devices, such as semiconductor physics, diode and transistor operation, and semiconductor materials.
CLOBJ 2	Analyse and describe the characteristics and behaviour of various electronic devices, including diodes, transistors, and amplifiers.
CLOBJ 3	Apply circuit analysis techniques to understand and design basic electronic circuits involving devices like diodes and transistors.
CLOBJ 4	Understand the principles of signal amplification and processing using electronic devices, including amplifier configurations and feedback systems.
CLOBJ 5	Comprehend the principles of digital electronics, including logic gates, flip-flops, and digital circuit design.

CLOBJ 6	Analyse and design circuits using operational amplifiers, including applications in amplification, filtering, and signal conditioning.
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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 Analyse different type biasing circuit.
CLO 5	Analyse 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	0	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%	4
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	10%	4

	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.		
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	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%	9
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 configuration, transistor amplifier circuit using H parameter, comparison , linear analysis of transistor, physical model of CB transistor.	25%	12
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, preregulation, 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	45

i. Text Book and Reference Book:

1. Electronic Principles (TextBook) By A. P. Malvino | Tata McGraw Hill Publication New Delhi. | 7
2. Electronic Devices and Circuits By Jacob Millman and Halkias | Tata McGraw Hill Publication New Delhi.
3. Electronic Devices and Circuits By Robert L. Boylestad and Louis Nashelsky | Pearson, Prentice Hall.
4. Electronic Devices By Thomas L. Floyd | Pearson, Prentice Hall
5. Linear Electronic Circuits and Devices By James Cox, | Delmar Publication.
6. Electronic Devices and Circuits by David A. Bell | Oxford Publication

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 (b) To Plot and Study input-output characteristics of common Emitter (CE) 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	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
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(5)

- 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%	7
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%	7
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%	9
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%	9

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%	4
7	Motion And Power Transmission Devices Shaft and Axle; Belt Drive; Chain Drive; Friction Drive; Gear Drive; Clutch, Coupling and Brake.	5%	2
8	Conventional And Non-Conventional Energy Sources Introduction and Classification of Energy Sources; Conventional 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.	5%	2
	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.

(6)

- a. **Course Name:** Mathematics-II
- b. **Course Code:** 303191151
- c. **Prerequisite:** Knowledge of Mathematics up to 12th science level
- d. **Rationale:** The Mathematics I 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.	Topics	Weightage	Teaching Hours
1	UNIT 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	UNIT 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	UNIT 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	UNIT 4 Fourier Integral: Fourier Integral, Fourier Cosine Integral and Fourier Sine Integral	17%	10
5	UNIT 5 Vector Calculus: Gradient of scalar field, Directional Derivative, Divergence and curl of Vector field, Scalar line integrals, vector line integrals,	10%	6

	scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.		
6	UNIT 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 (Text Book) 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 (Text Book) By Howard Anton, Chris Rorres Willy India Edition 9th Edition
5.	Advanced Engineering Mathematics (Text Book) By Erwin Kreyszig Willey India Education
6.	A text book of Engineering Mathematics By N.P. Bali and Manish Goyal Laxmi Publications

(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	10%	2

	Farwell speeches		
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
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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 behaviour and design and analysis of closed loop control systems

e. Course Learning Objective:

CLOBJ 1	Understand how analog and digital systems can be integrated to form complete electronic systems.
CLOBJ 2	Explore real-world applications of analog and digital electronics in various fields, such as communication, control systems, and signal processing.
CLOBJ 3	Develop problem-solving skills related to electronic circuit analysis and design.
CLOBJ 4	Gain hands-on experience through laboratory exercises to reinforce theoretical concepts and develop practical skills.
CLOBJ 5	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 to obtain 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 as root 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 system identification problem in the laboratory

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20	0	60	0	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	Introduction to Control Systems Introduction, Examples of Control Systems, Closed-Loop Control versus n-Loop Control, Digital Computer Control, The Control.	5%	2
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%	7
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%	4

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 Approach to Control-Systems Design	10%	4
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 versus Phase plots	15%	7
9	Stability in frequency domain Introduction, Mathematical Preliminaries, Nyquist stability criterion, assessment of relative stability using Nyquist criterion	10%	4
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%	4
	Total	100	45

i. Text Book and Reference Book:

1. Modern Control System By Richard C. Dorf and Robert H. Bishop | Pearson 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

- a. Course Name:** Control Theory Lab
- b. Course Code:** 303111204
- 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 behaviour and design and analysis of closed loop control systems
- e. Course Learning Objective:**

CLOBJ 1	Students will develop a deep understanding of the theoretical principles behind control systems, including concepts such as feedback, stability, controllability, and observability.
CLOBJ 2	Students will gain hands-on experience in designing, analyzing, and implementing control systems using modern tools and techniques.
CLOBJ 3	Analyze experimental data to identify system parameters, evaluate system performance, and validate theoretical concepts.
CLOBJ 4	Students will acquire skills in analyzing data from control systems experiments, including identifying system parameters and evaluating system performance.
CLOBJ 5	Students will work in teams to complete laboratory assignments, improving their teamwork and communication skills.

f. Course Learning Outcomes:

CLO 1	Understand a comprehension of control system theory and its application in real-world systems.
CLO 2	Apply theoretical concepts to design, analyze, and implement control systems using modern tools and techniques.
CLO 3	Analyze experimental data to identify system parameters, evaluate system performance, and validate theoretical concepts.
CLO 4	Design experiments and develop solutions to control system problems, demonstrating creativity and innovation.
CLO 5	Evaluate the effectiveness of control systems through experimental design and data analysis, identifying areas for improvement.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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 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 impulse on a simulator
5	To obtain the transfer function from the state model and state space from transfer function
6	Simulation of DC motor Working using state space model in MATLAB
7	To obtain the time response of a given second order system with its damping frequency
8	Simulation of Transfer Function of RC Circuit in MATLAB Software
9	Plotting root loci of a given transfer function using a simulator
10	Plotting phase magnitude plot of a given transfer function with a simulator
11	To control the closed loop system using PID controller

(2)

- a. **Course Name:** Analog and Digital Electronics Theory
- 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:

CLOBJ 1	Define and explain fundamental control system concepts, including open-loop and closed-loop systems, feedback, and control objectives.
CLOBJ 2	Develop the ability to create mathematical models of dynamic systems using differential equations, transfer functions, and block diagrams.
CLOBJ 3	Analyse the stability of linear time-invariant systems using stability criteria such as the Routh-Hurwitz criterion and the Nyquist criterion.
CLOBJ 4	Understand and analyse the transient and steady-state responses of systems to different inputs.
CLOBJ 5	Apply frequency domain analysis techniques, such as Bode plots and Nyquist diagrams, to understand system behaviour 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 to Analog conversion

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	1	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	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%	7
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%	9
3	3 Nonlinear applications of Op-Amp: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular wave generators. Precision rectifier, peak detector	10%	4
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%	9
5	Sequential Circuits and Systems: A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, JK-T	20%	9

	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.		
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 ICs, 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%	7
	Total	100	45

i. Text Book and Reference Book:

1. OPAMP & Linear Integrated Circuits (Text Book) By Ramakant Gaiekwad | PHI
2. Fundamentals of Digital Electronics (Text Book) 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

- a. Course Name:** Analog and Digital Electronics Lab
- b. Course Code:** 303113202
- 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:**

CLOBJ 1	Identify and understand the function of basic electronic components such as resistors, capacitors, diodes, and transistors.
CLOBJ 2	Analyze simple analog and digital circuits using circuit analysis techniques, including Kirchhoff's laws and Ohm's law..
CLOBJ 3	Design and build basic analog and digital circuits to meet specified requirements, demonstrating understanding of circuit design principles.

CLOBJ 4	Use electronic test equipment such as multimeters, oscilloscopes, and function generators to measure and characterize electronic circuits.
CLOBJ 5	Understand and implement basic digital logic circuits, including gates, flip-flops, counters, and registers.

f. Course Learning Outcomes:

CLO 1	understand a comprehension of control system theory and its application in real-world systems.
CLO 2	Apply theoretical concepts to design, analyze, and implement control systems using modern tools and techniques.
CLO 3	Analyze experimental data to identify system parameters, evaluate system performance, and validate theoretical concepts.
CLO 4	Design experiments and develop solutions to control system problems, demonstrating creativity and innovation.
CLO 5	Evaluate the effectiveness of control systems through experimental design and data analysis, identifying areas for improvement.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	Study the different parameter of op-amp
2	Frequency response of inverting amplifier and non-inverting amplifier.
3	Study of op-amp as inverting amplifier and non-inverting amplifier.
4	OPAMP circuits –integrator, differentiator, and comparator
5	Phase shift and Wein's Bridge oscillator with amplitude stabilization 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	10. Verification of function of Latch and flip-flop.
11	11. Verification of counter circuit like binary up/down counter, decimal counter, ring counter, Johnson counter etc.
12.	Verification of Specification and Performance indices of D/A and A/D converters

(3)

- a. **Course Name:** Electrical Machines Theory
- 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 motors 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	0		3	20	20	0	60	0	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	Principle of Electromechanical Energy Conversion Magnetic circuits - Singly excited systems - doubly excited systems - Force and Torque. Induction Motors - Introduction	5%	2
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%	9
3	AC / DC Servomotors Servomotors: Types – Constructional features - Principle of operation – Feedback system - Sizing of servomotors – Applications	15%	7
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%	9
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 -applications	20%	9

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%	9
	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 | McGraw Hill Education
3. Basic Electrical Engineering , By D. P. Kothari and I. J. Nagrath, | Tata McGraw Hill3, Pub. Year 2010
4. Electrical Machine By Bhattacharya S. K | McGraw Hill Education
5. Rotating Machinery analysis By M.Adams | Marcel Dekker, New York | 01

a. **Course Name:** Electrical Machines Lab

b. **Course Code:** 303113204

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	Understand the basic principles of operation of electrical machines, including motors and generators.
CLOBJ 2	Identify different types of electrical machines, such as DC machines, induction machines, and synchronous machines, and describe their characteristics and applications.
CLOBJ 3	Analyze the operating characteristics of electrical machines, including torque-speed curves, efficiency, and power factor.
CLOBJ 4	Describe the construction and components of electrical machines, including rotor, stator, windings, and core.
CLOBJ 5	Perform basic performance analysis of electrical machines, including calculations related to power, torque, and efficiency.
CLOBJ 6	Understand methods for controlling and regulating the speed and torque of electrical machines, including voltage and frequency control.

f. Course Learning Outcomes:

CLO 1	Understand the operation and behavior of electrical machines through hands-on experiments, linking theoretical concepts to practical applications.
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CLO 2	Apply experimental skills to operate and control electrical machines, demonstrating understanding of machine behavior under different operating conditions.
CLO 3	Analyze the performance characteristics of electrical machines using measured data, such as efficiency, power factor, and torque-speed curves.
CLO 4	Evaluate machine performance and efficiency, comparing experimental results with theoretical predictions and industry standards.
CLO 5	Design and conduct tests to determine machine parameters and ratings, showcasing creativity in experimental setup and data collection.
CLO 6	Collaborate with peers to conduct experiments safely and effectively, fostering teamwork and communication skills.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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

h. 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 Arduinio.
4	To understand and perform different operation of stepper motor using Arduinio.
5	To understand working BLDC motor with Arduinio.
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:** Network Analysis and Synthesis Theory
- b. Course Code:** 303122201

- c. **Prerequisite** : Fundamental knowledge of calculus (Integration, differentiation, etc.) and Linear Algebra (Determinant, Matrices) etc
- d. **Rationale**: The Students of EC Engineering are expected to be able to analyze and synthesize circuits using various laws and theorems. This is one of the foundation courses offering understanding of concepts and developing of skills required to analyze and synthesize real word problems circuits in the field of Electronics fundamentals.

e. Course Learning Objective:

CLOBJ 1	Define network synthesis and its role in electronic circuit design. Understand the importance of systematic approaches to network design.
CLOBJ 2	Introduce impedance and admittance parameters in the context of network synthesis. Understand the relationships between these parameters and the characteristics of passive components.
CLOBJ 3	Define image impedance and its role in simplifying network analysis. Understand how transfer functions are used to represent network behavior.
CLOBJ 4	Explore various network theorems and techniques used in synthesis, including reciprocity, duality, and insertion loss. Apply these theorems to simplify and analyze network configurations.
CLOBJ 5	Introduce elementary synthesis procedures for the design of passive networks. Understand how to create networks with desired impedance characteristics.

f. Course Learning Outcomes:

CLO 1	Understand basics electrical circuits with nodal and mesh analysis
CLO 2	Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, Millman's Theorem, etc.
CLO 3	Apply Laplace Transform for steady state and transient analysis..
CLO 4	Determine different network functions
CLO 5	Appreciate the frequency domain techniques

g. Teaching & Examination Scheme:

Teaching Scheme	Evaluation Scheme
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L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	20	20	0	60	0	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	Basic Concepts :Node and mesh analysis, matrix approach of network containing voltage and current sources, and reactance, source transformation and duality, coupled Circuit Analysis: dot convention	15%	7
2	Graph Theory :Graph of a network, definitions, tree, Co-tree, link, basic loop and basic cut set, Incidence matrix, Cut set matrix, Tie set matrix, Duality, Loop and Nodal methods of analyses.	10%	4
3	Network Theorems Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation and Tallegen's theorem as applied to AC. circuits	15%	7
4	Laplace Transform and network analysis :Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions	15%	7
5	The Frequency domain Fourier analysis :Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation	15%	7
6	Network Function Synthesis and Two port Networks :Transient behaviour, concept of complex frequency, Driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem, Characterization of LTI two port networks; Z, Y, ABCD, g and h parameters, Reciprocity and symmetry, Inter-relationships between the parameters, Interconnections of two port networks	20%	9

7	Filters: Behaviours of series and parallel resonant circuits, Introduction to band pass, low pass, high pass and band reject filters	10%	4
	Total	100	45

i. Text Book and Reference Book:

1. Network Analysis By M. E. Van Valkenburg | PHI Learning
2. Circuit Theory By Chakrabarti | Dhanpat Rai & Co.
3. Networks and Systems By D. Roy Choudhary | Wiley Eastern Ltd
4. Engineering Circuit Analysis By W H Hayt, S M Durbin | Tata McGraw-Hill Education
5. Engineering circuit analysis with PSPICE and probe By Roger

a. Course Name: Network Analysis and Synthesis Lab

b. Course Code: 303122202

c. Prerequisite : Fundamental knowledge of calculus (Integration, differentiation, etc.) and Linear Algebra (Determinant, Matrices) etc

d. Rationale: The Students of EC Engineering are expected to be able to analyze and synthesize circuits using various laws and theorems. This is one of the foundation courses offering understanding of concepts and developing of skills required to analyze and synthesize real word problems circuits in the field of Electronics fundamentals.

e. Course Learning Objective:

CLOBJ 1	Gain a thorough understanding of basic concepts in network analysis, including network theorems, impedance transformations, and two-port network parameters..
CLOBJ 2	Develop practical skills in analyzing linear electrical networks using various methods, such as nodal analysis, mesh analysis, and the use of network theorems.
CLOBJ 3	Learn to design and synthesize networks to meet specified performance criteria, considering aspects such as impedance matching, filter design, and frequency response shaping.
CLOBJ 4	Develop practical skills in using laboratory equipment to measure and analyze electrical networks, and gain experience in validating theoretical concepts through practical experiments.

CLOBJ 5	Enhance problem-solving and critical thinking skills by applying theoretical concepts to analyze and solve complex network problems.
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f. Course Learning Outcomes:

CLO 1	Understand basics electrical circuits with nodal and mesh analysis
CLO 2	Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, Millman's Theorem, etc.
CLO 3	Apply Laplace Transform for steady state and transient analysis..
CLO 4	Determine different network functions
CLO 5	Appreciate the frequency domain techniques

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	To Verify Loop Analysis and Nodal Analysis using KVL and KCL 2 3. To verify Thevenin's theorem
2	To verify superposition theorem
3	To verify Thevenin's theorem
4	To verify maximum power transfer theorem
5	To verify reciprocity theorem
6	To measure and calculate RC and RL time constant for a given RC circuit
7	To measure and analyze step response of for a given series RLC circuit
8	To measure and calculate Z-parameters for a given two-port system
9	To measure and calculate Y-parameters for a given two-port system
10	To Design Passive Low Pass filter and verify the Frequency Response.
11	To Design Passive Band Pass filter and verify the Frequency Response.

(5)

a. **Course Name:** Material Engineering Theory

b. **Course Code:** 303122203

c. **Prerequisite :** Knowledge of Engineering Physics and Engineering Chemistry

d. **Rationale:** Basic principles of science are used to study the structure-properties relationship 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	Describe the atomic and molecular structure of materials.
CLOBJ 2	Explain mechanical, thermal, electrical, and optical properties of materials.
CLOBJ 3	Evaluate and select materials based on specific engineering requirements.
CLOBJ 4	Learn various methods of material synthesis and processing.
CLOBJ 5	Use different techniques to characterize materials, such as microscopy, spectroscopy, and mechanical testing.
CLOBJ 6	Collaborate with peers on projects involving material selection and design.

f. **Course Learning Outcomes:**

CLO 1	Understand the properties and characteristic of engineering materials.
CLO 2	Identify the properties of metals with respect to crystal structure and grain size
CLO 3	Interpret the phase diagrams of materials.
CLO 4	Describe about the ferrous, nonferrous metals and alloys.

CLO 5	Describe the concept of heat treatment of steels & strengthening mechanisms.
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g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	-	0	3	20	20	0	60	0	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	Engineering Materials and Crystal Structures: Classification of Engineering Materials, Engineering requirements of materials, Criterion for selection of materials for engineering applications through Structure-Properties Performance correlation ship. Unit Cell, Crystal structure, Bravais lattice, atomic packing factor, coordination number, crystal directions and planes, Miller indices, Imperfections in crystals and their effect on properties, Strain hardening, Recovery, Recrystallization and Grain Growth.	15%	7
2	Phase Diagrams and Theory of Alloys:Unary and Binary equilibrium phase diagrams, Lever rule, Gibbs phase rule, solid solutions and compounds, Solid Solution Strengthening Mechanisms, Hume-Rothery rules; cooling curves, Different reactions like eutectic, eutectoid etc. Allotropy of Iron, Iron-Iron-Carbide equilibrium diagram. Plain carbon steels, its classification and properties, Alloy Steel, its classification and properties, Stainless steel, Tool Steel, designation of Steels, Effect of alloying elements like Cr, Mo, Ni, W, V, Nb, B, Al, etc on the Properties of Steel, Cast Iron, its classification and properties, White Cast iron, Grey	25%	11

	Cast iron, Nodular Cast iron, Malleable Cast iron, Chilled Cast Iron etc.		
3	Heat Treatment of Steels and Alloys: Heat Treatment Cycle, Time-Temperature-Transformation (TTT) Diagram, CCR, Different types of heat Treatments like Annealing, Normalizing, Hardening, Tempering, Austempering, Martempering, Ausforming, Surface hardening and Case hardening treatments, Jominy Hardenability Test.	15%	7
4	Non-Ferrous Alloys, Non Metallic Materials and Nanomaterials: Copper alloys, Aluminium alloys: Classification, Composition, Properties and applications. Plastics, Composites, Ceramics: Classification, Composition, Properties and applications. Introduction to Nanomaterials and its applications.	20%	9
5	Powder Metallurgy: Production of Powder, blending, Compacting, Sintering; Application, advantages and limitations..	10%	4
6	Non Destructive Testing: Principle, Advantages, limitations and Applications of Dye Penetration Testing, Magnetic Particle Testing, Eddy current testing Radiography Testing, Ultrasonic Testing.	10%	4
7	Metallography :Structure of Metals, Macro-examination: Macro-etching; Microscopic examinations: Specimen Preparation, etching, grain size measurement; Concept of chemical analysis of steel and Iron for Carbon, Sulphur & Phosphorous	5%	3
	Total	100	45

i. Text Book and Reference Book:

1. Introduction to Physical Metallurgy By Sydney H. Avner | Tata McGraw-Hill
2. Callister's Material Science and Engineering, 2 By R. Balasubramaniam | Wiley India.
3. Materials Science and Engineering: By V. Raghavan | A First Course, 5th Edition Prentice Hall India, 2004.
4. Mechanical Metallurgy By George E. Dieter | McGrawhill book company
5. Practical Non-Destructive Testing, By Baldev Raj, T. Jayakumar and M. Thavasimuthu | Narosa Pub. House

a. Course Name: Material Engineering Lab

b. Course Code: 303122204

c. Prerequisite : Knowledge of Engineering Physics and Engineering Chemistry

d. Rationale: Basic principles of science are used to study the structure-properties relationship 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	Gain hands-on experience with various techniques used to characterize materials, such as microscopy, spectroscopy, and mechanical testing.
CLOBJ 2	Learn methods for synthesizing and processing materials, including casting, sintering, and heat treatment, to achieve desired properties.
CLOBJ 3	Perform tests to determine material properties, such as tensile strength, hardness, and thermal conductivity, and analyze the results to understand material behavior.
CLOBJ 4	Learn various methods of material synthesis and processing.
CLOBJ 5	Use different techniques to characterize materials, such as microscopy, spectroscopy, and mechanical testing.
CLOBJ 6	Learn to identify and analyze material failures using techniques such as fractography and root cause analysis, and propose solutions to prevent future failures.

f. Course Learning Outcomes:

CLO 1	Understand the properties and characteristic of engineering materials.
CLO 2	Identify the properties of metals with respect to crystal structure and grain size
CLO 3	Interpret the phase diagrams of materials.
CLO 4	Describe about the ferrous, nonferrous metals and alloys.
CLO 5	Describe the concept of heat treatment of steels & strengthening mechanisms.

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. Experiment List :

Sr. No.	Experiment List
1	Study of Engineering Materials and its Classification.
2	Demonstration of Metallurgical Micro Scope.
3	Specimen Preparation for Micro Structural Examination.
4	Observation of Micro Structure for Standard Samples.
5	Demonstration on Heat Treatment of Steels.
6	Study of Powder Metallurgy.
7	Demonstration of Liquid Penetrant Test/Dye Penetrant Test.
8	Demonstration of Magnetic Particle Test.
9	Flaw Detection through Ultrasonic Testing.
10	Demonstration of Jominy Hardenability Test

(6)

- a. Course Name:** Product Realization
- b. Course Code:** 303106213
- 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
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g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	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
1	Topic-1: Introduction of Design Thinking • Overview, objective and goal of this course, • What is Design Thinking? - Its importance, socio-economical relevance, Systematic problem identification & problem solving approaches. • Observation: Through AEIOU.
2	Topic-2: Ideation Phase • Preparation of Ideation canvas. • Brainstorming (What, Why, How, When, For Whom). • Situation/Context/Location, Props/non-living, things/tools/equipment.
3	Topic-3: Mind map • Begin with the main concept. • Determine the main purpose of your mind map & add branches that will outline the most basic subtopics. • Explore topics by adding more branches.
4	Topic-4: Empathy Map • Define scope and goals. • Gather materials. Your purpose should dictate the medium you use to create an empathy map. • Converge to cluster and synthesize. • Polish and plan.
5	Topic-5: Product Development Phase • Discussion on Product Development Canvas (PDC) • Preparation of Product Development Canvas (PDC)
6	Topic-6: Feedback & Final Report • Upload duly signed • Continuous Assessment Card.

(7)

- a. **Course Name:** Professional Communication Skills
- b. **Course Code:** 303193203
- c. **Prerequisite:** Knowledge of English language in practical life
- d. **Rationale:** To make students understand basic concepts of electronics and instrumentation which will help them to create new innovation
- 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 identify, 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

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

h. Course Content:

Sr.	Content	Weightage	Teaching Hrs.
1	Technical Writing: Email etiquette & Email writing Letter Writing (Types of Letters & Layout): - 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 analyse 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:** Basics of Signal & Systems Theory
- b. **Course Code:** 303113255
- c. **Prerequisite :** Inclination to learn mathematics, basic knowledge of differential equations and difference equations, electrical circuits and networks
- 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-time signals.
CLOBJ 2	Perform basic operations on signals, including addition, multiplication, and convolution.
CLOBJ 3	Analyze signals and systems in the time domain.
CLOBJ 4	Study system properties such as linearity, time-invariance, causality, and stability.
CLOBJ 5	Introduce the Laplace transform for behaviour signals and systems in the complex frequency domain.
CLOBJ 6	Introduce the Z-transform for discrete-time signal and system analysis.

f. Course Learning Outcomes:

CLO 1	Understand the characteristics of different types of signals.
CLO 2	Understand the behaviour of different types of systems.
CLO 3	Analyze the system in various domains using different transformation methods, like, Fourier transform, Z- transform, etc.,
CLO 4	Check the stability of the system

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.	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%	9
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 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%	7
	Total	100	45

i. Text Book and Reference Book:

1. Introduction to Physical Metallurgy By Sydney H. Avner | Tata McGraw-Hill
2. Callister's Material Science and Engineering, 2 By R. Balasubramaniam | Wiley India.
3. Materials Science and Engineering: By V. Raghavan | A First Course, 5th Edition Prentice Hall India, 2004.

4. Mechanical Metallurgy By George E. Dieter | McGrawhill book company
 5. Practical Non-Destructive Testing, By Baldev Raj, T. Jayakumar and M. Thavasimuthu | Narosa Pub. House

- a. **Course Name:** Basics of Signal & Systems Lab
 b. **Course Code:** 303113256
 c. **Prerequisite :** Inclination to learn mathematics, basic knowledge of differential equations and difference equations, electrical circuits and networks
 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	Gain a practical understanding of basic signal properties such as amplitude, frequency, and phase, and how these properties are represented in different domains (time, frequency).
CLOBJ 2	Learn to generate and manipulate signals using various techniques, such as signal addition, multiplication, and modulation.
CLOBJ 3	Develop skills in analyzing signals using tools like Fourier transforms, Laplace transforms, and z-transforms to understand their frequency and time-domain characteristics.
CLOBJ 4	Understand the behavior of linear time-invariant (LTI) systems, including concepts such as impulse response, convolution, and system transfer functions.
CLOBJ 5	Apply signal and system analysis techniques to design and evaluate systems for specific applications, such as filters, amplifiers, and modulators.
CLOBJ 6	Gain hands-on experience with signal generation equipment, oscilloscopes, and other measurement tools used in signal processing and system analysis.

- f. **Course Learning Outcomes:**

CLO 1	Apply signal processing techniques to analyze and manipulate signals, such as filtering, modulation, and noise removal..
CLO 2	Analyze the frequency content of signals using Fourier transforms and identify key signal characteristics.

CLO 3	Design and implement signal processing systems to achieve specific objectives, such as filtering out noise or extracting specific signal components
CLO 4	Develop new approaches to signal processing problems based on a synthesis of theoretical concepts and practical considerations.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	To Familiarize With Matlab Software, General Functions and Signal Processing Toolbox Functions.
2	To Generate The Following Waveform Using Matlab In Continuous and Discrete Time. 1) Sine 2) Cosine 3) Square 4) Saw Tooth Wave.
3	To Generate The Following Waveform 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 circular convolution of two given sequences
10	To write a Matlab program to verify the time shifting properties of DFT
11	To write a Matlab program to verify the linearity properties of DFT.

(2)

- a. **Course Name:** Fundamental of Robotics and Robot Kinematics
- b. **Course Code:** 303122251
- c. **Prerequisite:** To understand the basic knowledge of kinematics of mechanisms. To understand the basic components and layout of linkages in the assembly of mechanisms. To introduce basics of robotics (Links, Actuators, Sensors etc.) To learn the concept of direct kinematics and inverse kinematics.
- d. **Rationale:** To apply various theories for analysis and synthesize mechanism and solution skills
- e. **Course Learning Objective:**

CLOBJ 1	Define the field of robotics and understand its applications in various industries. Explore the historical development and evolution of robotics.
CLOBJ 2	Identify and describe the main components of a robot, including actuators, sensors, controllers, and end-effectors.
CLOBJ 3	Introduce Cartesian, cylindrical, and spherical coordinate systems in the context of robotics. Understand transformations between different coordinate systems
CLOBJ 4	Study forward kinematics to determine the end-effector position and orientation.
CLOBJ 5	Solve inverse kinematics problems to determine joint angles required for a desired end-effector position and orientation. Understand the challenges and solutions associated with inverse kinematics.
CLOBJ 6	Analyse the velocity of robot motion using Jacobian matrices. Study the relationship between joint velocities and end-effector velocities.

f. Course Learning Outcomes:

CLO 1	Explain the fundamentals of robotics and its components.
CLO 2	illustrate the kinematics and dynamics of robotics.
CLO 3	illustrate the movement of robotic joints with computers/microcontrollers.
CLO 4	Explain sensors and instrumentation in robotics.
CLO 5	Perform kinematic analysis of mechanisms and serial & parallel manipulators.

CLO 6	Analyse velocity and acceleration of mechanisms by vector and graphical methods.
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g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	0	0	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	Basic Concepts in Robotics Automation and robotics, Robot anatomy, Basic structure of robots, Resolution, Accuracy and repeatability, and Classification and Structure of robots, Point to point and continuous path systems. 20 12	15%	9
2	Robotic System and Control Systems Components of robotic system, Hydraulic systems, D.C. servo motors, Basic control systems concepts and models, Control system analysis, Robot activation and feedback components. Positional and velocity sensors, actuators. Power transmission systems.	15%	9
3	Sensors and Instrumentation in Robotics Tactile sensors, proximity and range sensors, Force and torque sensors, Uses of sensors in robotics. Vision equipment, Image processing, Concept of low level and high level vision	15%	9
4	Basics of kinematics 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%	6
5	Velocity and Acceleration Analysis Velocity and Acceleration Diagrams, Instantaneous Centre of Velocity, Rubbing Velocity, Velocity and Acceleration Images,	15%	9

	Coriolis component of acceleration. Special Mechanisms: Straight line mechanism, Indicator diagrams, Hookes Joint, Steering Mechanisms		
6	Non Destructive Testing: Principle, Advantages, limitations and Applications of Dye Penetration Testing, Magnetic Particle Testing, Eddy current testing Radiography Testing, Ultrasonic Testing.	15%	9
7	Robot arm Kinematics and Dynamics Robot joints, The direct kinematics problem, The inverse kinematics solution, Lagrange-Euler formation, Generalized D'Alembert equations of motion, Denavit Hartenberg convention and its applications	15%	9
	Total	100	60

i. Text Book and Reference Book:

1. Introduction to Robotics By S. K. Saha | Mc Graw Hill publication
2. Fundamentals of Robotics, Analysis & Control by Schilling By Robert J., | Prentice Hall of India.
3. Introduction to Robotics, Mechanics and control By John J. Craig, Addison – Wesley.
4. Introduction to Robotics: Analysis, Systems, Applications By A. B. Niku | Prentice Hall
5. Theory of Machine By R. S. Khurmi and J. K. Gupta | S. Chand

a. Course Name: Fundamental of Robotics and Robot Kinematics lab

b. Course Code: 303122252

c. Prerequisite: To understand the basic knowledge of kinematics of mechanisms. To understand the basic components and layout of linkages in the assembly of mechanisms. To introduce basics of robotics (Links, Actuators, Sensors etc.) To learn the concept of direct kinematics and inverse kinematics.

d. Rationale: To apply various theories for analysis and synthesize mechanism and solution skills

e. Course Learning Objective:

CLOBJ 1	Gain a foundational understanding of robotics, including the history, key concepts, and applications.
CLOBJ 2	Learn to analyze the motion of robots using kinematic principles, including forward and inverse kinematics.
CLOBJ 3	Learn to model the geometry and behavior of robotic systems, including manipulators and mobile robots.

CLOBJ 4	Understand the principles of robot control, including both open-loop and closed-loop control strategies.
CLOBJ 5	Gain hands-on experience in programming robots, including using simulation tools and real hardware
CLOBJ 6	Understand the ethical considerations and safety measures involved in designing and operating robotic systems.

f. Course Learning Outcomes:

CLO 1	Develop innovative solutions to challenges in robot kinematics and control.
CLO 2	Apply kinematic equations to analyze and predict the motion of robotic manipulators.
CLO 3	Analyze the impact of different robot designs on their kinematic performance.
CLO 4	Evaluate the effectiveness of sensor integration in improving robotic perception.
CLO 5	Design and implement a robotic system to accomplish a specific task.
CLO 6	Develop innovative solutions to challenges in robot kinematics and control.

g. Teaching & Examination Scheme:

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

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	To study and understand the working of wire robots (DTMF)
2	To study and understand the working of wireless robot (Bluetooth Based).
3	To study and understand about ultrasonic based self-operating robot.
4	To study and understand the working of line follower robot.
5	To study and understand working of wi-fi operated robot.
6	To study & understand the working of camera drone
7	To study about concept of manipulator kinematics
8	Verify concept of velocity analysis and prepare sheet for the same

9	Verify concept of acceleration analysis by preparing sheet.
10	Analysis of special mechanisms

(3)

- a. **Course Name:** Sensors and Transducers
- b. **Course Code:** 303122253
- 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:**

CLOBJ 1	Define sensors and transducers and understand their roles in measurement and control systems.
CLOBJ 2	Understand the fundamental principles behind sensing, including transduction mechanisms and sensing modalities.
CLOBJ 3	Classify sensors based on different criteria such as the nature of the measured property, transduction principle, and application.
CLOBJ 4	Introduce signal conditioning techniques for sensor outputs.
CLOBJ 5	Study temperature sensing principles and various types of temperature sensors.
CLOBJ 6	Understand pressure sensing principles and different types of pressure sensors.

- 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					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	-	1	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	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	15%	7
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).	25%	11
3	Force, Magnetic and Heading Sensor Strain Gauge, Load Cell, Magnetic Sensors -types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclometers.	20%	9
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%	11

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.	15%	7
	Total	100	45

i. Text Book and Reference Book:

1. A course in electrical & Electronic measurement and instrumentation By A.K.Sawhney | Dhanpat Rai
2. Engineering Metrology and Instrumentation By R.K.Rajput

a. Course Name: Sensors and Transducers Lab

b. Course Code: 303122254

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:

CLOBJ 1	•Gain a thorough understanding of the working principles behind different types of sensors and transducers (e.g., resistive, piezoelectric, inductive).
CLOBJ 2	•Develop proficiency in using laboratory equipment for sensor and transducer characterization.
CLOBJ 3	•Apply knowledge of sensor characteristics to select appropriate sensors for specific measurement tasks.
CLOBJ 4	•Gain an understanding of the role of sensors and transducers in real-world engineering applications.
CLOBJ 5	•Acquire hands-on experience in designing and implementing signal conditioning circuits for sensor outputs.
CLOBJ 6	•Explore the characteristics of sensors and transducers, including static and dynamic behaviour.

f. Course Learning Outcomes:

CLO 1	evaluate the suitability of different sensors for specific measurement tasks based on their characteristics and limitations.
CLO 2	design a basic sensor-based system to address a simple engineering problem.
CLO 3	analyze data obtained from sensor measurements and identify potential errors or limitations.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	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 meter.
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.

(4)

- a. **Course Name:** Manufacturing Technology Theory
- b. **Course Code:** 303122255
- c. **Prerequisite:** Workshop Practices, and Engineering Graphics.
- d. **Rationale:** The course explores various manufacturing processes, various casting and metal forming processes, and metal cutting processes.
- e. **Course Learning Objective:**

CLOBJ 1	Define manufacturing and understand its significance in various industries.
CLOBJ 2	Identify and classify different types of materials used in manufacturing.
CLOBJ 3	Introduce and classify different manufacturing processes, including machining, casting, forming, and additive manufacturing.
CLOBJ 4	Identify and describe common machine tools used in manufacturing, such as lathes, milling machines, and CNC machines.
CLOBJ 5	Understand metal cutting processes, including turning, milling, and drilling.
CLOBJ 6	Explore different casting processes, including sand casting, die casting, and investment casting.

- f. **Course Learning Outcomes:**

CLO 1	Select appropriate casting and forming processes along with their parameters.
CLO 2	Calculate the single-point cutting tool forces during the metal cutting operation.
CLO 3	Design the press tool dies for blanking and drawing applications.
CLO 4	Select and apply suitable metal joining processes
CLO 5	Compare and select appropriate manufacturing process for the given component.

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	1	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.	Content	Weightage	Teaching Hours
1	Metal Casting and Forming processes Fundamentals of metal casting, Mouldings and its types and Properties, Patterns - types of patterns, selection of patterns, pattern allowances, Cores - types and shaping process, Classifications of castings - according to mould materials and moulding methods (like sand, shell-mould, CO2 mould casting, Cold box, Hot box, Investment, Centrifugal, Die casting), Fettling and finishing of castings, Inspection of castings, Defects in castings. Numerical on design of sprue. Hot working and cold working; principle, purpose, relative advantages and applications. Classification of forming processes: Forging - Upset, Impression, Roll. Forging defects and inspection, calculation of force and pressure. (Von-Mises criteria). Rolling - Classification of rolling Processes - types of rolling mill. Extrusion - Direct, Indirect, impact, hydro. Shape factor, Drawing; principle of wire drawing, methods of wire drawing, methods of tube drawing, calculation of force and pressure. (Numerical based on wire drawing only)	25%	11
2	Metal Cutting & Tool Engineering Metal Cutting: Mechanism of chip formation, Effect of various parameters on cutting forces, concept of shear plane, chip reduction coefficient, velocity diagram and concept of oblique and orthogonal cutting. Merchant's force circle, Expression for shear plane angle, shear strain, shear force, normal shear force, friction and normal friction force, friction angle and coefficient of friction. Calculation of Power, Material removal rate, specific energy, efficiency of machine tools. Numerical based on merchant force circle (analytical and graphical). Tool Engineering: Geometry of single point cutting tool, Tool life definition, Tool wear and failure, factors Influencing tool life such as speed, feed, depth of	24%	11

	cut, tool material, cutting fluids etc. Taylor's tool life equation (Numerical) and Machinability.		
3	Machine Tools Introduction- Classifications of manufacturing processes, characteristics of material removal processes, need and purpose of conventional material removal processes. Lathe – Constructional features, classification, operations- facing, plain turning, drilling, knurling etc., threading cutting process (single start multiple start) and gear train, taper turning methods and calculations. Types of tools for various operations, accessories and attachments, Calculation of Machining time. Milling – Constructional features, classification, face and peripheral milling, up milling and down milling processes, Types of tools for various operations, dividing head attachment, operations on milling machine, gear milling, Machining time. Numerical based on indexing methods and machining time. Drilling – Constructional features, classification, Types of tools and work holding devices, tool holding devices - tapping, quick change chuck, floating holder. Operations on drilling machine, machining time. Numerical based on machining time. Introduction to CNC, Word address format (WAF)	25%	11
4	Press work Mechanics of shearing, classification of press, types of drives, operations, clearance, strip layout, centre of pressure, methods to reduce cutting force: shear and staggering of punch. Numerical based on above topics. Types of dies- Cutting: piercing, blanking and progressive. Forming: drawing and bending, design of piercing, blanking, drawing die. Numerical based on types of dies.	10%	5
5	Welding Processes Weldability, weld symbols, weld joints, edge preparation, classification of welding, Arc welding: principle, controlling parameters, types: tungsten inert gas, metal inert gas, shielded metal arc welding – advantages, limitations and applications, defects, causes and remedy Resistance welding: principle, advantages, limitations and applications, types: spot, seam, projection. Principle, advantages, limitations and applications, Numerical. Electron beam welding, Laser beam welding, Friction welding, Ultrasonic welding, Stud welding,	16%	7
	Total	100	45

i. Text Book and Reference Book:

1. Metal cutting Principles. Trent McGraw Hill
2. Production Technology By R.K. Jain | Khanna Pub.

3. Elements of Workshop Technology (Vol I & Vol II) By Hajra Choudhary | Media Promoters and Publishers Pvt ltd
4. Workshop Technology (Vol I & Vol II) By B.S Raghuwanshi | Dhanpatrai
5. Welding processes and technology By Dr.R.S.Parmar | Khanna Publishers

- a. **Course Name:** Manufacturing Technology Lab
- b. **Course Code:** 303122256
- c. **Prerequisite:** Workshop Practices, and Engineering Graphics.
- d. **Rationale:** The course explores various manufacturing processes, various casting and metal forming processes, and metal cutting processes.

e. Course Learning Objective:

CLOBJ 1	Students will be able to compare and contrast different manufacturing processes based on their suitability for specific materials and applications.
CLOBJ 2	interpret engineering drawings and specifications to determine manufacturing requirements.
CLOBJ 3	design and develop simple jigs and fixtures to aid in production.
CLOBJ 4	demonstrate safe practices and proper handling of equipment in the laboratory environment.
CLOBJ 5	troubleshoot common problems encountered during manufacturing operations and identify potential causes of errors.
CLOBJ 6	operate and utilize various machines and equipment used in manufacturing processes (e.g., lathes, milling machines, welding equipment).

f. Course Learning Outcomes:

CLO 1	Interpret engineering drawings and specifications to determine manufacturing requirements, including material selection, machining parameters, and quality control procedures.
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CLO 2	Design and develop simple jigs and fixtures to aid in production processes, demonstrating an understanding of how these tools can improve efficiency and accuracy.
CLO 3	Troubleshoot common problems encountered during manufacturing operations
CLO 4	Explain the fundamental principles behind various manufacturing processes, including material properties, machining parameters, and quality control procedures.
CLO 5	Plan and execute manufacturing processes to produce parts or components according to specified requirements, demonstrating flexibility in adapting to different production scenarios.

g. Teaching & Examination Scheme:

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

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	Study of pattern, allowances and pattern making.
2	Study of various types of cutting tools and measurement of tool geometry.
3	Determination of chip-thickness ratio and shear angle during Machining.
4	Demonstration on Lathe Machine
5	Demonstration on Drilling and Milling Machine.
6	To study the basic concept of press working operations
7	Study and measure the Spring Back effect in V bending.
8	Performance of gas welding and gas cutting process
9	Demonstration on TIG and MIG Welding.
10	To study the working principle of Resistance Welding process

(5)

- a. **Course Name:** Communication Protocols for Robotics Theory
- b. **Course Code:** 303122257
- c. **Prerequisite:** Knowledge of Basic Electronics
- d. **Rationale:** The course provides introductory treatment of the field of Industrial control and its interfaces for engineers.
- e. **Course Learning Objective:**

CLOBJ 1	Define the importance of communication in robotic systems.
CLOBJ 2	Introduce fundamental concepts of data communication, including data transmission, encoding, and modulation.
CLOBJ 3	Differentiate between serial and parallel communication methods.
CLOBJ 4	Explore and analyze communication standards commonly used in robotics, such as RS-232, RS-485, and CAN (Controller Area Network).
CLOBJ 5	Introduce different network topologies, including star, bus, and ring topologies.
CLOBJ 6	Break down communication into layers, such as the OSI (Open Systems Interconnection) model.

f. Course Learning Outcomes:

CLO 1	Understand the concept of industrial control and applications.
CLO 2	Understand various interfaces and protocols.
CLO 3	Learn wireless communication and data communication

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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.	Content	Weightage	Teaching Hours
1	Introduction to Electronic Communications Electronic Communications Systems, Modulation and Demodulation, electromagnetic frequency spectrum, noise	10%	5
2	Analog Modulation Transmission and Reception Principles of Amplitude Modulation (AM), AM modulating circuits, AM transmitters, AM receivers, AM receiver circuits, DSB-SC, SSB, VSB	30%	13
3	Angle Modulation Transmission and Reception Angle Modulation, deviation sensitivity, phase deviation and modulation index, phase and frequency modulators and demodulators, bandwidth requirements of angle modulated waves, deviation ratio, phasor representation, FM transmitters, FM versus AM, FM versus PM, FM receivers.	30%	13
4	Digital Modulation and Transmission Information capacity, bits, bit rate and baud, ASK, FSK and PSK, quadrature amplitude modulation, bandwidth efficiency, differential PSK, pulse modulation, pulse code modulation (PCM), PCM sampling, signal to quantization noise ratio, coding methods, delta modulation PCM, Adaptive delta modulation PCM.	20%	9
5	Cellular Telephone and Wireless Communication Concepts Mobile telephone services, evolution of cellular telephone, frequency reuse, interference, cell splitting, sectoring, second generations of mobile communication systems, call processing, cellular system topology, global system for mobile communication, personal satellite communication system, introduction to 3G & 4G, introduction to wireless communication.	10%	5
	Total	100	45

i. Text Book and Reference Book:

1. Electronic Communications Systems By Wayne Tomasi | Pearson education India
2. Electronic Communication system By G. Kennedy | Tata M. Graw Hill, 1996
3. Electronic Communication By D. Roddy and J. Coolen | Prentice Hall, 4th edition, 1995

- a. **Course Name:** Communication Protocols for Robotics Lab
- b. **Course Code:** 303122258
- c. **Prerequisite:** Knowledge of Basic Electronics
- d. **Rationale:** The course provides introductory treatment of the field of Industrial control and its interfaces for engineers.
- e. **Course Learning Objective:**

CLOBJ 1	Explain the fundamental concepts of communication protocols, including network topologies, data transmission methods, and error detection/correction techniques.
CLOBJ 2	Identify and differentiate between common communication protocols used in robotics
CLOBJ 3	Configure and operate communication interfaces between robotic components
CLOBJ 4	Interpret and troubleshoot communication errors or data transmission issues within a robotic system
CLOBJ 5	evaluate the suitability of different communication protocols for specific robotic applications considering factors like bandwidth requirements, real-time constraints, and network complexity.
CLOBJ 6	Design a communication architecture for a simple robotic system, selecting appropriate protocols and implementing necessary hardware/software components

f. Course Learning Outcomes:

CLO 1	Design a communication architecture for a given robotic system, selecting appropriate communication protocols
CLO 2	Demonstrate safe practices when working with electronic components and robotic equipment.
CLO 3	Develop basic communication software programs using appropriate programming languages or tools to enable data exchange between robotic elements.

g. Teaching & Examination Scheme:

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

0	0	2	1	0	0	20	0	30	50
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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	Study about Communication System.
2	Study the DSBFC modulation and demodulation of sine wave and observe the output waveform.
3	Study SSB-SC modulation and observe the output waveform.
4	Study SSB-SC demodulation and observe the output waveform
5	Study the frequency modulation and observe the output waveform
6	Study the frequency demodulation and observe the output waveform.
7	Study ASK technique and observe the output waveform.
8	Study FSK technique and observe the output waveform.
9	Study PSK technique and observe the output waveform.
10	Study PCM technique and observe the output waveform

(7)

- a. Course Name** Professional Grooming & Personality Development
- b. Course Code:** 203193252
- 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 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.	Topic	Weightage	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.
Communication Skills Kumar S and Lata P; New Delhi Oxford University Press
2. Practical English Usage MICHAEL SWAN A Remedial English Grammar for Foreign Student F.T. WOOD
3. On Writing Well William Zinsser; Harper Paperbacks, 2006; 30th anniversary edition
Oxford Practice Grammar, John Eastwood; Oxford University Press

4. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
Communication Skills Kumar S and Lata P; New Delhi Oxford University Press

Semester 5

(1)

- a. **Course Name:** Python Programming
- b. **Course Code:** 203105211
- c. **Prerequisite:** Programming Concepts
- d. **Rationale:** Python is a modern language useful for writing compact codes specifically for programming in the area of Server-side Web development, Data Analytics, AI and scientific computing as well as production tools and game programming. This course covers the basics and advanced Python programming to harness its potential for modern computing requirements.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the basic syntax, data types, and structures of the Python programming language.
CLOBJ 2	Recognize the differences between Python and other programming languages.
CLOBJ 3	Understand and use control structures such as loops, conditionals, and functions
CLOBJ 4	Design and implement classes and objects in Python.
CLOBJ 5	Understand concepts like inheritance, encapsulation, and polymorphism in Python.
CLOBJ 6	Understand file operations, file formats, and data serialization techniques.

- f. **Course Learning Outcomes:**

CLO 1	Understand how to Program.
CLO 2	Use Python syntax.
CLO 3	Differentiate types of implementations
CLO 4	Interpret programs written using python
CLO 5	Relate Object oriented programming to python programming
CLO 6	Develop mini-projects using python.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	0	2	-	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	Introduction to Python : Installation and Working with Python, Features, Python Interpreter and Its Working, Syntax and Semantics, Python Variables, Immutable Variables and Blocks.	5%	2
2	Python Data Types Data Types, Declaring and Using Numeric and String Data Type, String Operations, Assignments, Operators, Expressions, Comments	20%	6
3	Program Flow Control Conditional Blocks Using if, else and elif, For loop, While loops, Loop Manipulation using Pass, Continue, Break	15%	5
4	Python Functions, Modules and Packages Organizing Python Codes Using Functions and Modules, Importing Modules, Introduction to Packages, Lambda Function	20%	6
5	String, List Tuple and Dictionary Introduction to String, List, Tuple and Dictionary, working with in-built Methods of String and List, Tuple and Dictionary Manipulation using in-built Methods	15%	4
6	Exceptional Handling	10%	3

	Exception, Types of Errors, Handling an Exception, try, except, else, finally clause, Argument of an Exception, Raising an Exception		
7	File Handling Files, Types of Files in Python, Read and Write Functions, Working with Text Files, Manipulating File Pointer Using Seek and Tell, and Various File Operations	15%	4
	Toatl	100	30

i. Text Book and Reference Book:

1. Introducing Python by Lubanovic Bill, O' ReILLY (TextBook)
2. Beginning Python: Using Python 2.6 and Python 3.1 (TextBook) By James Payne | Wrox Publication

a. Course Name: Python Programming Lab

b. Course Code:203105212

c. Prerequisite: Programming Concepts

d. Rationale: Python is a modern language useful for writing compact codes specifically for programming in the area of Server-side Web development, Data Analytics, AI and scientific computing as well as production tools and game programming. This course covers the basics and advanced Python programming to harness its potential for modern computing requirements.

e. Course Learning Objective:

CLOBJ 1	identify basic Python syntax elements like variables, data types (integers, strings, booleans, etc.), operators, and control flow statements (if/else, loops).
CLOBJ 2	explain the fundamental concepts of Python programming, such as object-oriented programming principles and modularity.
CLOBJ 3	write basic Python programs to perform simple operations like calculations, data manipulation, and user input/output.
CLOBJ 4	compare and contrast different approaches to solving a programming problem using Python, considering factors like efficiency and code readability
CLOBJ 5	design and implement Python programs to solve more complex problems, potentially involving functions, data structures

CLOBJ 6	debug syntax errors and logical errors in their Python code, identifying the root cause of the issue.
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f. Course Learning Outcomes:

CLO 1	Write Python programs to perform common operations like calculations, data manipulation, and user input/output.
CLO 2	Debug and troubleshoot syntax and logical errors in their Python code.
CLO 3	Evaluate the effectiveness of their chosen solution based on the problem requirements.
CLO 4	design and implement Python programs of Data structures like lists, dictionaries, and tuples for data organization
CLO 5	identify and define basic Python syntax elements like variables, data types
CLO 6	Communicate their programming approach and problem-solving strategies through written reports, presentations, or discussions.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	Practical-1 WAP to read and display the following information. Name, Address, Phone no.
2	Practical-2 WAP to read two numbers from the keyboard and display the larger one on the screen.
3	Practical-3 WAP to find, a given number is PRIME or NOT.
4	Practical-4 Write a Function to swap values of a pair of integers.
5	Practical-5 WAP to find N! Using function.
6	Practical-6

	WAP to print Fibonacci series of 'n' numbers, where n is given by the programmer.
7	Practical-7 WAP to read a set of numbers in an array & to find the largest of them
8	Practical-8 WAP to sort a list of names in ascending order.
9	Practical-9 WAP to read a set of numbers from keyboard & to find the sum of all elements of the given array using a function
10	Practical-10 Calculate area of different geometrical figures (circle, rectangle, square, and triangle).
11	Practical-11 WAP to increment the employee salaries on the basis of their designation (Manager-5000, General Manager-10000, CEO20000, worker-2000). Use employee name, id, designation and salary as data member and inc_sal as member function.
12	Practical-12 WAP to read data from keyboard & write it to the file. After writing is completed, the file is closed. The program again opens the same file and reads it.

(2)

- a. **Course Name:** Computer Integrated Manufacturing and Lab
- b. **Course Code:** 203122304
- c. **Prerequisite:** Fundamentals of Machine Design Drawing and Manufacturing Processes
- d. **Rationale:** Computers have become inevitable in today era and find their application in various stages of product development. This course intends to introduce students to use of computers in the phases of product design viz. conceptualisation, geometric modelling, graphical representation, CNC part programming for milling and turning.
- e. **Course Learning Objective:**

CLOBJ 1	Define and explain the concept of Computer Integrated Manufacturing.
CLOBJ 2	Discuss the historical evolution and the importance of CIM in modern manufacturing.
CLOBJ 3	Introduce students to software tools commonly used in CIM like Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and Manufacturing Execution Systems (MES).
CLOBJ 4	Understand the role of automation in CIM and how various manufacturing processes are interconnected.

CLOBJ 5	Study various manufacturing processes like machining, casting, forming, and assembly and understand how they can be integrated using CIM.
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f. Course Learning Outcomes:

CLO 1	Understand and appreciate the use of computer in product design and development process
CLO 2	Understand the basics of product design and the role of manufacturing automation
CLO 3	The students will get a comprehensive picture of computer based automation of manufacturing operations.
CLO 4	To understand the importance of automation in the of field machine tool based manufacturing , to get the knowledge of various elements of manufacturing automation – CAD/CAM, Sensors, pneumatics, hydraulics and CNC.
CLO 5	Apply greater depths of technical knowledge in the areas of design using modeling and analysis software's

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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	Content	Weightage	Teaching Hours
1	Fundamentals of CIM Introduction, Computerized elements of a CIM System, Components of CIM, Database for CIM, Planning, Scheduling and Analysis of CIM Systems. CIM Wheel. Evolution, Benefits of CIM.	15%	6
2	Manufacturing Systems And CNC Machines	35%	16

	Manufacturing systems - types, current trends. Fundamentals of CNC machines- principles of operation - features - Classification -Developments, Machining Centres, its Economics. interpolations - Open loop and closed loop control systems - CNC controllers -Direct Numerical Control, Adaptive Control - Machine structures, slide ways, linear bearings, Recirculating ball screws, Drives - spindle and feed drives Feedback devices.		
3	CNC Part Programming Introduction to Part Programming, G codes and M codes, Canned Cycle, Codes used in Turning Centre and Machining Centre, APT Language	20%	9
4	Group Technology and Cellular Manufacturing Introduction, objectives, benefits, part families, parts classification and coding systems: OPTIZ, Production Flow Analysis, Cellular Manufacturing, and Rank Order Clustering. Flexible Manufacturing System: Introduction, Components, Application and Benefits. FMS Planning and Implementation Issues	20%	9
5	Computer Aided Process Planning Generative and variant types of CAPP with their advantages, Advance Planning Concepts: MRP-I & MRP-II, ERP, Concept of design for manufacturing and assembly.	10%	5
	Total	100	45

i. Text Book and Reference Book:

1. Automation production systems and computer – integrated manufacturing By Mikell P.Groover | Prentice Hall of India
2. Manufacturing Engineering and Technology By Seropekalakjian | Wesley longman (Singapore) pvt.ltd
3. Computer control of manufacturing system By YoramKoren | 1st
4. CAD/CAM Theory & Practice By Ibrahim Zeid | Tata McGraw Hill
5. System Approach to Computer Integrated Design and Manufacturing By Singh | John willey
6. Manufacturing and Automation Technology By R Thomas Wright and Michael Berkeihiser | Willcox Publisher

- a. **Course Name:** Computer Integrated Manufacturing Lab
- b. **Course Code:** 203122304
- c. **Prerequisite:** Fundamentals of Machine Design Drawing and Manufacturing Processes
- d. **Rationale:** Computers have become inevitable in today era and find their application in various stages of product development. This course intends to introduce students to use of computers in the phases of product design viz. conceptualisation, geometric modelling, graphical representation, CNC part programming for milling and turning.
- e. **Course Learning Objective:**

CLOBJ 1	explain the fundamental concepts of computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE) and their roles within CIM
CLOBJ 2	Utilize CAD software to create basic 2D and 3D models of mechanical components
CLOBJ 3	Generate toolpaths using CAM software for various machining operations (milling, turning)
CLOBJ 4	Interpret and analyze manufacturing data generated by CNC machines and other CIM components
CLOBJ 5	Identify and troubleshoot potential issues arising during the manufacturing process based on the data analysis.

f. Course Learning Outcomes:

CLO 1	Identify and troubleshoot potential issues arising during the manufacturing process based on data analysis.
CLO 2	Design and simulate integrating CAD models for parts.
CLO 3	Generating toolpaths for machining operations.
CLO 4	Developing basic PLC programs for machine control
CLO 5	Interpret and analyze manufacturing data from CNC machines and other CIM components

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	Study of Construction of CNC machines and systems.
2	Prepare part programming for CNC milling.
3	Prepare part programming for CNC turning.
4	Exercise on Flexible manufacturing systems and group technology
5	Exercise on Cellular Manufacturing using Rank Order Clustering
6	Exercise on Production Planning and Control Systems (Advanced Concepts- MPS, MRP-I, MRP-II,)
7	Exercise on Production Planning and Control Systems (ERP)
8	Exercise on Production Planning and Control Systems (JIT, Lean Manufacturing, Agile Manufacturing)
9	Exercise on Production Planning and Control Systems (Lean Manufacturing, Agile Manufacturing)
10	Exercise on Process Planning, CAPP and Advanced Process Planning

(3)

a. Course Name: Microcontrollers and Interfacing for Robotics Theory

b. Course Code: 203122309

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 basic principles and components of robotic systems, including actuators, sensors, and control systems.
CLOBJ 2	Gain a deep understanding of the architecture, instruction set, and memory organization of microcontrollers commonly used in robotics.
CLOBJ 3	Learn to interface various sensors (e.g., proximity, vision, inertial) with microcontrollers for sensing the robot's environment
CLOBJ 4	Study motor control techniques and the interfacing of actuators such as DC motors, servo motors, and stepper motors with microcontrollers
CLOBJ 5	Understand the principles of embedded system design tailored for robotic applications, including hardware-software co-design and real-time processing

f. Course Learning Outcomes:

CLO 1	Explain 8085 microprocessor architecture
CLO 2	Understand the Architecture for Microcontroller 8051
CLO 3	Program Microcontroller using assembly and C languages
CLO 4	Define issues related to Programming, Run-time Environment
CLO 5	Analyze the Micro controller systems specification and develop software programs

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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.	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 and their 8051 Assembly language interfacing programming	40%	16
	Total	100	45

i. Text Book and Reference Book:

1. 8051 Microcontroller & Embedded system using assembly & C (TextBook)
By Muhammad Mazidi | Pearson | Second
2. 8051 microcontroller & Embedded system using assembly & C (TextBook)
By K J Ayala | CENGAGE | Second
3. Programming and Customizing the 8051 Microcontroller by Myke Predko
Tata Mcgraw Hill. By Myke Predko | Tata Mcgraw Hill
4. The 8051 Microcontrollers, Architecture and programming and Applications
By K.Uma Rao, AndhePallavi | Pearson

a. Course Name: Microcontrollers and Interfacing for Robotics Lab

b. Course Code: 203122310

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	Demonstrate proficiency in programming microcontrollers using high-level programming languages and assembly language, to control various robotic systems and peripherals.
CLOBJ 2	Design and implement interface circuits to connect sensors (e.g., proximity sensors, encoders, accelerometers) and actuators (e.g., motors, servos, pneumatics) to microcontroller-based robotic systems.
CLOBJ 3	Develop and implement control algorithms for robotic systems, utilizing sensor feedback and closed-loop control techniques to achieve desired behavior and functionality.
CLOBJ 4	Design, build, and test robotic prototypes using microcontroller platforms, integrating sensors, actuators, and control electronics to perform specific tasks or operations.

CLOBJ 5	Implement communication protocols (e.g., UART, SPI, I2C) for data exchange between microcontrollers and peripheral devices, enabling seamless integration and interoperability within robotic systems.
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f. Course Learning Outcomes:

CLO 1	Analyze the performance of microcontroller-based robotic systems through experimentation and data analysis, evaluating factors such as response time, accuracy, and efficiency.
CLO 2	Evaluate the effectiveness of control algorithms in achieving desired robotic behaviors, considering factors such as stability, robustness, and adaptability to varying conditions.
CLO 3	Assess the reliability and robustness of microcontroller-based robotic systems under different operating conditions, identifying strengths, weaknesses, and areas for improvement.
CLO 4	Synthesize knowledge of microcontroller programming, interfacing techniques, and control algorithms to develop custom solutions for robotic tasks and challenges.
CLO 5	Design and implement innovative robotic systems by integrating microcontrollers with sensors, actuators, and communication modules, to address specific application requirements.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	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]

(4)

- a. **Course Name:** Robot Dynamics and Manipulator Design
- b. **Course Code:** 303122307
- c. **Prerequisite:** Fundamental Knowledge of Robot Kinematics and Mechanics of Solid is required.
- d. **Rationale:** This course provides an introduction to basic principles of designing simple components. It covers application of Mechanics of Solids for designing any components.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the principles of robot kinematics and dynamics, including the analysis of manipulator motion, velocities, accelerations, and forces, to model and simulate the behavior of robotic systems.
CLOBJ 2	Explore the design principles of robot manipulators, including link lengths, joint types, end-effectors, and workspace analysis, with a focus on optimizing manipulator configurations for specific applications.
CLOBJ 3	Integrate control systems with manipulator dynamics, studying the principles of closed-loop control, feedback control, and the implementation of algorithms for trajectory planning, position control, and end-effector coordination.
CLOBJ 4	Explore the integration of sensors and perception systems into robotic manipulators, including the understanding of sensor types (e.g., vision, force, tactile), and the application of perception data for real-time decision-making.
CLOBJ 5	Develop skills in optimizing robotic systems for efficiency, speed, accuracy, and energy consumption, considering factors such as payload capacity, workspace constraints, and end-effector design.

f. Course Learning Outcomes:

CLO 1	To formulate and apply design process for components under static load.
CLO 2	To analyze design of components under fluctuating loads.
CLO 3	To evaluate strength of welded and bolted joints.
CLO 4	To understand the complete design procedure of the robot manipulator.
CLO 5	To select correct mechanism for operation of the robot subject to dynamics
CLO 6	To select necessary actuators, sensors, control for satisfactory performance of the robot

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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.	Content	Weightage	Teaching Hours
1	Introduction & Design of simple Machine parts Machine design, basic procedure of machine design, design of machine elements, selection of materials, standards and codes, modes of failure, factor of safety, theories of elastic failure. Design for strength and rigidity Case studies of transmission shafts, square and flat keys, couplings, power screw.	20%	9
2	Design against fluctuating Loads Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, endurance limit, design for finite and infinite life, Soderberg and Goodman diagrams, Modified Goodman diagrams	15%	7

3	Threaded joints and Welded joints Basic types of screw fastenings, bolt of uniform strength, ISO metric screw threads, bolted joint simple analysis Welded joints, strength of butt welds, strength of parallel fillet welds, strength of transverse fillet welds	15%	7
4	Robot Manipulators Design Statics of robot manipulators: Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Singularity analysis and statics. Robot Manipulator Design process-Kinematic design, configuration, structural design & analysis, level of control, Servo system design & analysis, Detailed design and System integration & Debugging	25%	11
5	Dynamics of Robot Manipulators Dynamics of serial robots: Mass and inertia of links, Lagrangian formulation for equations of motion for serial manipulator, dynamic equations of motion, Actuation of single link with single rotary joint, Dynamic model of 2 DoF planar RR Manipulator, Dynamic model requirement of spatial manipulator, Recursive dynamics.	25%	11
	Total	100	45

i. Text Book and Reference Book:

1. Fundamentals of Machine Component Design, By Juvinall, R.C., and Marshek, K.M. | 4th Ed., John Wiley & Sons
2. Design Data Hand Book, By Mahadevan, K., and B., Reddy | CBS Publishers
3. Introduction to Robotics, By S. K. Saha | Mc Graw Hill publication
4. Introduction to Robotics: Analysis, Systems, Applications, By A. B. Niku | Prentice Hall
5. Design of Machine Elements, By V B Bhandari | McGraw Hill.
6. Robotics and Control, By R K Mittal, I. J. Nagrath | Tata Mc Graw-Hill

a. Course Name: Robot Dynamics and Manipulator Design Lab

b. Course Code: 303122308

c. Prerequisite: Fundamental Knowledge of Robot Kinematics and Mechanics of Solid is required.

d. Rationale: This course provides an introduction to basic principles of designing simple components. It covers application of Mechanics of Solids for designing any components.

e. Course Learning Objective:

CLOBJ 1	Gain a comprehensive understanding of the fundamental principles governing the dynamics of robotic systems, including kinematics, kinetics, and control theory.
CLOBJ 2	Analyze the kinematic properties of robotic manipulators, including forward and inverse kinematics, velocity, and acceleration analysis, to determine the end-effector motion for given joint configurations
CLOBJ 3	Perform experimental validation of theoretical concepts and design methodologies through hands-on experiments with robotic manipulators in a laboratory setting, using motion capture systems and sensors for data acquisition.
CLOBJ 4	Design and optimize robotic manipulators for specific tasks and applications, considering factors such as workspace, payload capacity, accuracy, and speed requirements.
CLOBJ 5	Implement control strategies such as inverse dynamics control, trajectory planning, and feedback control to achieve precise and efficient motion control of robotic manipulators.

f. Course Learning Outcomes:

CLO 1	Apply kinematic equations to solve forward and inverse kinematics problems for robotic manipulators.
CLO 2	Implement dynamic models to predict the motion and behavior of robotic manipulators under various conditions.
CLO 3	Analyze the impact of different parameters such as mass distribution, friction, and external forces on the dynamic behavior of robotic manipulators.
CLO 4	Critically evaluate the effectiveness of control strategies in achieving desired motion and manipulation tasks.
CLO 5	Design robotic manipulators to meet specified performance requirements and constraints, considering factors such as workspace, joint limitations, and end-effector capabilities.
CLO 6	Synthesize knowledge of robot dynamics and control theory to develop innovative solutions for complex manipulation tasks.

g. Teaching & Examination Scheme:

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

0	0	2	1	0	0	20	0	30	50
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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	Design Project. ONE design project on Robot Manipulator covering, various elements like, links, joints, transmission shaft, rigid flange coupling, base support, gripper, sensor (selection), actuator (selection) flexible coupling, screw jack, helical springs, etc. The project should be assigned to a group of four students. The design project shall consist of two half imperial sheets (A2 size). First sheet containing assembly drawing with a bill of material and second sheet containing detail drawings of individual components with tolerances. Drafting should be done using any 2D or 3D software package. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components.
2	Case Study Case study on Dynamic analysis of planar manipulator (Analytical work along with simulation using MATLAB, SCILAB or any suitable Robotic analysis software)

(5)

- a. **Course Name** Professionalism & Corporate Ethics
- b. **Course Code:** 20319304
- c. **Prerequisite:** Basic knowledge of ethics, corporate etiquettes and understanding of the fundamentals of communication are essential.
- d. **Rationale :** Interpersonal skills and ethics are essential for placemen
- 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	Identify 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%	3
2	Group Discussion: • Communication core • Definition, types, process, guidelines • Mock round -1	10%	1

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 & solve questions based on it.	10%	2
5	Preparing Brochures: Students will learn how to establish the purpose of writing & determine audience they are writing for.	15%	2
6	Agenda & Minutes of Meeting: Students will be able to explain what an agenda & minutes of meeting are and why they are useful.	10%	2
7	Reading Comprehension; Intermediate level: Students will develop their ability to skim for main idea(s). They will be 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.	20%	3
	Total	100	15

i. Reference Books:

1. Business Correspondence and Report Writing SHARMA, R. AND MOHAN, K.
2. Ethics in Engineering Practice and Research Caroline Whitbeck, Cambridge University Press
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, TATA McGRAW HILL

(6) Open Electives

(7) PEC 01

- a. **Course Name:** Computer Aided Design and Analysis
- b. **Course Code:** 303122331
- c. **Prerequisite:** Mechanics of Solids, Matrix Methods of Structural Analysis and Structural Analysis
- d. **Rationale:** Complicated geometries, loadings, and material properties, analytical solutions generally require the solution of ordinary or partial differential equations, which are not usually obtainable. Hence, the structural engineers need to rely on numerical methods, such as the finite element method, finite difference method, and boundary element method etc., for acceptable solutions. Among these numerical methods, finite element method is such a widely accepted method that can be systematically programmed to accommodate complex and difficult problems.
- e. **Course Learning Objective:**

CLOBJ 1	Acquire a foundational understanding of Computer-Aided Design (CAD) principles and tools.
CLOBJ 2	Demonstrate proficiency in creating 2D and 3D models using CAD software.
CLOBJ 3	Master the fundamentals of Computer-Aided Engineering (CAE) for analysis and simulation.
CLOBJ 4	Apply CAD techniques in real-world engineering and design projects.
CLOBJ 5	Explore advanced features of CAD systems for complex design scenarios.

f. **Course Learning Outcomes:**

CLO 1	Understand and appreciate the use of computer in product design and development process.
CLO 2	Apply algorithms for graphical entity generation.
CLO 3	Generate 3D models of mechanical engineering components.
CLO 4	Derive and use 1-D and 2-D element stiffness matrices and load vectors for solving displacements and stresses.
CLO 5	Explain the workings of a finite element code for linear stress, displacement, temperature and modal analysis for a given FEA software.
CLO 6	Apply greater depths of technical knowledge in the areas of design using modelling and analysis software.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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.	Content	Weightage	Teaching Hours
1	Introduction Product cycle, sequential and concurrent engineering, Computer Aided Design.	15%	7
2	COMPUTER GRAPHICS Scan conversion, DDA and Bresanham's algorithms for generation of line and circle. 2D and 3D Transformations.	20%	9
3	GEOMETRIC MODELING Curves introduction: Analytic curves, synthetic curves, Hermit cubic spline, Bezier curve, B-spline curve and NURBS. Surfaces introduction: Surface entities, analytic surfaces, synthetic surfaces such as Hermit cubic, Bezier, B-spline. Solids 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%	11
4	FEA FUNDAMENTALS Introduction – Steps involved in FEA; Nodes – Elements and their types, shape function – constraints, force and nodal displacements – Stiffness matrix - solution techniques. Simple problems involving stepped bar subjected to axial loading and simple structural members with triangular element. FEA in CAD Environment: Stages of FEA in CAD environment – Pre-processor, Solver and Postprocessor.	25%	11
5	Pre-processor and Post Processor Pre-processors for FEA modelling, FEA software packages and Applications.	15%	7
	Total	100	45

i. Text Book and Reference Book:

- 1. CAD/CAM Theory & Practice** By Ibrahim Zeid | Tata McGraw Hill
- 2. CAD/CAM Principles** By C. McMohan and J. Browne | Pearson Education | Second Edition
- 3. Principles of Computer Graphics** By W. M. Neumann and R.F. Sproul | McGraw
- 4. Computer Graphics** By Donald Hearn & M. Pauline Baker | PHI,2011 | Second Edition

a. Course Name: Computer Aided Design and Analysis Lab

b. Course Code:303122332

c. Prerequisite: Mechanics of Solids, Matrix Methods of Structural Analysis and Structural Analysis

d. Rationale: Complicated geometries, loadings, and material properties, analytical solutions generally require the solution of ordinary or partial differential equations, which are not usually obtainable. Hence, the structural engineers need to rely on numerical methods, such as the finite element method, finite difference method, and boundary element method etc., for acceptable solutions. Among these numerical methods, finite element method is such a widely accepted method that can be systematically programmed to accommodate complex and difficult problems.

e. Course Learning Objective:

CLOBJ 1	understanding of various CAD software tools commonly used in engineering and design, such as AutoCAD, SolidWorks, CATIA, or similar programs.
CLOBJ 2	Develop the ability to create accurate 2D and 3D models of mechanical components, assemblies, and systems using CAD software, including skills in sketching, dimensioning, and geometric constraints.
CLOBJ 3	Learn how to apply CAD software for analysis purposes, including stress analysis, kinematic analysis, thermal analysis, and fluid flow analysis. Understand how to interpret analysis results and make design decisions based on them.
CLOBJ 4	Develop the ability to collaborate with team members on design projects using CAD software, including version control, file sharing, and collaborative editing.
CLOBJ 5	Understand the principles of project management as applied to CAD/CAM projects, including task scheduling, resource allocation, and project documentation.

f. Course Learning Outcomes:

CLO 1	Utilize analysis tools within CAD software to perform stress analysis, kinematic analysis, and thermal analysis.
CLO 2	Apply CAD software tools to create 2D and 3D models of mechanical components and assemblies.
CLO 3	evaluate design alternatives based on performance, cost, and manufacturability.
CLO 4	Innovate and design novel solutions to engineering problems using CAD/CAM tools.
CLO 5	Develop detailed technical drawings and assembly instructions from CAD models.
CLO 6	Generate complex CAD models of mechanical systems incorporating multiple components and assemblies.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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 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.

- a. **Course Name:** Operational Research
- b. **Course Code:** 303122333
- c. **Prerequisite :** Basic Mathematics
- d. **Rationale:** Operations Research now a day widely used in the area of decision making for the real life problems. Managers and decision makers get idea for optimizing and approximating industrial problems. They not only strive to devise appropriate measures for problem solving but also apply scientific techniques to monitor the organizations ongoing activities such as production mix, transportation, queuing, assignment, dynamic, Integer, goal and game problem.
- e. **Course Learning Objective:**

CLOBJ 1	Master the application of mathematical models in decision-making processes.
CLOBJ 2	Demonstrate proficiency in utilizing analytical methods for problem-solving.
CLOBJ 3	Optimize resource allocation through the practical application of Operational Research techniques.
CLOBJ 4	Enhance organizational efficiency by employing strategic decision-making tools
CLOBJ 5	Develop a comprehensive understanding of how Operational Research contributes to effective problem-solving in various domains.

f. Course Learning Outcomes:

CLO 1	Identify and develop models for optimizing the management and production systems from the verbal description of the real system.
CLO 2	Facilitate quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.
CLO 3	Acquaint him / her with applications of optimization techniques to solve manufacturing and other industry related problems.
CLO 4	Expose him / her to the significance of various scientific tools and models that are available in the subject to take decisions in a complex environment.
CLO 5	Estimate manufacturing resource and just-in-time for proper planning.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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.	Content	Weightage	Teaching Hours
1	Operations Research: Origin of Operation Research, Historical Standpoint, Methodology, Different Phases, Characteristics, Scope and Application of Operations Research.	6%	3
2	Linear Programming Problem: Introduction, Requirement of LP, Basic Assumptions, Formulation of LP, General Statement of LP, Solution techniques of LP: Graphical Methods, Analytical Methods: Simplex, Big M and Two Phase, Sensitivity Analysis, Primal and Dual Problems, Economic Interpretation	14%	7
3	Transportation and Assignment Transportation Problems: definition, Linear form, Solution methods: North west corner method, least cost method, Vogel's approximation method. Degeneracy in transportation, Modified Distribution method, Unbalanced problems and profit maximization problems. Transshipment Problems. Assignment Problems and Travelling sales man Problem	20%	9
4	Network analysis: CPM and PERT, Concept of slack/float and its significance; Project cost analysis, crashing, resource smoothing and levelling, Applications in production systems	14%	6
5	Sequencing problems: Johnson Rule and its logic, methods of solution; n jobs two machines, n jobs 3 machines, 2 jobs M machines and n jobs M machines problems; Graphical and Heuristic methods; Applications and limitations.	7%	3

6	Decision Theory: Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, Hurwitz criterion, Decision tree	12%	5
7	Replacement theory: Introduction, Replacement of capital equipment which depreciated with time, replacement by alternative equipment, Group and individual replacement policy.	9%	4
8	Inventory Control Inventory classification, Different cost associated to Inventory, Economic order quantity, Inventory models with deterministic demands, ABC analysis.	9%	4
9	Queuing Theory: Basis of Queuing theory, elements of queuing theory, Kendall's Notation, Operating characteristics of a queuing system, Classification of Queuing models	9%	4
	Total	100	45

i. Text Book and Reference Book:

- 1. Introduction to Operations Research** By Hiller and Liebermann | tmh
- 2. Operations Research (Textbook)** By Hamdy A. Taha | Pearson Education
- 3. Operation Research : Theory and Application** By J.K.Sharma | Macmillan India Ltd
- 4. Operations Research** By D.S. Hira and P.K.Gupta | S. Chand Publications

a. Course Name: Operational Research Lab

b. Course Code: 303122334

c. Prerequisite : Basic Mathematics

d. Rationale: Operations Research now a day widely used in the area of decision making for the real life problems. Managers and decision makers get idea for optimizing and approximating industrial problems. They not only strive to devise appropriate measures for problem solving but also apply scientific techniques to monitor the organizations on going activities such as production mix, transportation, queuing, assignment, dynamic, Integer, goal and game problem.

e. Course Learning Objective:

CLOBJ 1	Apply mathematical modeling techniques, including linear programming, integer programming, and dynamic programming, to formulate and solve optimization problems in OR.
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CLOBJ 2	Analyze decision-making processes under uncertainty using decision trees, risk analysis, and probabilistic modeling techniques
CLOBJ 3	Design and implement simulation models to analyze complex systems and processes, incorporating stochastic variables and random events.
CLOBJ 4	Interpret simulation results to make informed decisions and optimize system performance.
CLOBJ 5	Develop OR-based solutions to improve efficiency, resource allocation, and decision-making in operations management contexts.

f. Course Learning Outcomes:

CLO 1	Assess the robustness and reliability of OR models and results, considering uncertainties and sensitivity analysis.
CLO 2	Apply OR techniques to solve practical problems in operations management, supply chain optimization, project scheduling, and other application areas.
CLO 3	Design innovative OR-based solutions to optimize resource allocation, improve operational efficiency, and support strategic decision-making in various domains.
CLO 4	Develop custom OR models and algorithms to address unique or specialized optimization and decision problems
CLO 5	Evaluate the impact of modeling assumptions and parameter variations on the outcomes of OR analyses.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	-	-	20	-	30	50

h. Experiment List :

Sr. No.	Experiment List
1	Introduction to Operation Research.
2	Solve problem using Linear Programming- Formulation & Graphical Method.
3	Solve problem using Linear Programming: Simplex Method.
4	Solve problem using Transportation Problem and Assignment Problem

5	Write a program based on Queuing Model.
6	Write a program based on Inventory Model.
7	Write a program based on Replacement Model.
8	Write a program based on Games Theory.
9	Write a program based on Decision Theory.
10	Write a program based on Network Analysis.

- a. **Course Name:** Nonconventional Manufacturing Techniques
- b. **Course Code:** 303122335
- c. **Prerequisite:** Basic conventional manufacturing
- d. **Rationale:** This subject is useful for study of various non-traditional machining processes, application of these machining methods in various fields, and Use of advance coating technology in various fields
- e. **Course Learning Objective:**

CLOBJ 1	Explore various non-conventional manufacturing techniques and compare with conventional methods.
CLOBJ 2	Select suitable non-conventional processes for suitable materials.
CLOBJ 3	Select optimum parameters for the respective machining process.
CLOBJ 4	Summarizes the merits and demerits of the non-traditional manufacturing process.
CLOBJ 5	Develop the ability to optimize non-conventional manufacturing processes to enhance productivity, minimize waste and improve overall efficiency.

- f. **Course Learning Outcomes:**

CLO 1	Students will be able to learn the principles of non-conventional manufacturing techniques, distinguishing them from traditional methods and recognizing their unique applications.
CLO 2	Students will able to gain knowledge and skills in selecting materials suitable for non-conventional processes, considering their properties and compatibility with specific manufacturing techniques.
CLO 3	Students will be able to enhance problem solving capabilities to troubleshoot issues related to the implementation of non-conventional techniques, promoting adaptability and effective resolution of challenges in manufacturing context.
CLO 4	Students will able to model develop mathematically and analyse various unconventional machining process.

CLO 5	Students will able to recognize the need of industries' current necessity and environment related issue.
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g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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	Content	Weightage	Teaching Hours
1	Module-1 Need for Non-traditional Machining: Classification, process selection-Ultrasonic machining principle, Transducer, Magnetostrictive material, Analysis for Material Removal Rate by Shaw, Effect of process parameters, Application.	10%	4
2	Module-2 Abrasive Jet Machining: Principle, Application, Advantages and disadvantages Variables in AJM. Water Jet Machining: Jet Cutting equipment, Principle, advantages, Practical Applications.	20%	9
3	Module-3 Electrochemical Machining: Principle. Faraday's Law, Determination Material Removal Rate, evaluation of metal removal rate, Dynamics of ECM process, Tool design, Advantages, Application, Limitation, Electro-chemical grinding, Deburring and Honing.	25%	11
4	Module-4 Electro Discharge Machining: mechanism of material removal, Basic EDM circuitry and principles of operation, Analysis of relaxation circuits, Concepts of critical resistance, Machining accuracy and surface finish. Tool Material, Di-electric fluid, Applications and limitations.	25%	11
5	Module-5 Laser Beam Machining: Lasing process and principle, population inversion, Principle of Ruby laser, Nd: YAG	10%	5

	Laser and CO ₂ Laser, Power control of laser output. Application. Electron Beam Machining: Basic principle, Controlling parameters and focal distance. Application Ion Beam Machining: Principle and Mechanism, Application, Plasma Arc Machining: Generation of Plasma, Equipment's, Torch, Classification, Direct and indirect torches and applications, parameters effecting cutting, Advantages.		
6	Module-6 Principle of Coating Technology: Mechanism, Chemical and Physical vapour deposition, Application, Electroforming, Metal Spraying, Metallic coating, Plasma flame spraying.	10%	5
	Total	100	45

i. Text Book and Reference Book:

- 1. Nonconventional Machining** By P K Mishra | Narosa Publishing House, 1997
- 2. Manufacturing Science** By A Ghosh and A K Mallik | Wiley Eastern, 1986
- 3. Materials and Processes in Manufacturing** By Ernest Paul DeGarmo, J. T. Black, Ronald A. Kohser | John Wiley & Sons.

j. Experiment List:

Sr. No.	Experiment List
1	Study Ultrasonic Machining Principles.
2	Study of Abrasive Jet Machining.
3	Study of Water jet machining.
4	Study of Electrochemical machining.
5	Study of Electro Discharge Machining
6	Study of Laser Beam Machining and its principles.
7	Study of Electron Beam Machining and its principles.
8	Study of Plasma Arc Machining and its principles.
9	Study of Principle of Coating Technology and its applications.
10	Study of Plasma flame spraying.

Semester 6

(1)

- 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 is 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	Understand the basic principles, components, and technologies used in industrial automation systems.
CLOBJ 2	Learn about different types of control systems, including PLCs (Programmable Logic Controllers), DCS (Distributed Control Systems), and SCADA (Supervisory Control and Data Acquisition) systems.
CLOBJ 3	Gain proficiency in programming PLCs using ladder logic, function block diagrams, or structured text.
CLOBJ 4	Understand the principles of process control, including feedback control loops, PID (Proportional-Integral-Derivative) controllers, and advanced control strategies.
CLOBJ 5	Study communication protocols and networking technologies commonly used in industrial automation, such as Ethernet/IP, Modbus, and Profibus.

- 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	0	0	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.	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%	5
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%	4
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.	17%	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%	10
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 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.	11%	4
	Total	100	45

i. Text Book and Reference Book:

1. Instrumentation engineer's handbook By B.G Liptak & Chilton Book Co., | Philadelphia
2. Process control Instrumentation technology By Curtis D Johnson, | PHI
3. Programmable logic Controllers Principles and applications By John w. Webb
Ronald A Reis
4. Process Control Principles and applications By Surekha Bhanot | Oxford University press

- a. **Course Name:** Industrial Automation Lab
- b. **Course Code:** 303113352
- c. **Prerequisite:** Basic knowledge of Digital Electronics, Integrated circuits and applications (op-amps) , sensors and transducer is 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	Gain a thorough understanding of the fundamental concepts and principles of industrial automation, including sensors, actuators, control systems, and communication protocols.
CLOBJ 2	Develop proficiency in programming languages commonly used in industrial automation, such as ladder logic, structured text, Function Block Diagrams (FBD), or Sequential Function Charts (SFC).
CLOBJ 3	Learn how to integrate various automation components, such as programmable logic controllers (PLCs), human-machine interfaces (HMIs), and sensors, into a cohesive industrial control system.
CLOBJ 4	Acquire skills in diagnosing, troubleshooting, and maintaining automated systems to ensure optimal performance and minimize downtime.
CLOBJ 5	Understand the importance of safety protocols in industrial automation and learn how to implement safety measures to protect personnel, equipment, and processes.

f. Course Learning Outcomes:

CLO 1	Apply Programming Concepts to Industrial Control Systems
CLO 2	Evaluate existing industrial automation systems to identify inefficiencies and propose improvements for enhanced performance.
CLO 3	Design a complete control system architecture for a specific industrial process, including PLC programming, HMI design, and sensor/actuator integration.
CLO 4	Diagnose faults in PLC programs or hardware components of an industrial automation system and propose solutions for troubleshooting.
CLO 5	Create detailed documentation of automation projects, including design specifications, implementation plans, and performance evaluations, and present findings effectively to stakeholders.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	Design and commissioning of a Programmable Logic Controllers (PLC).
2	To study and perform Programmable Logic Controllers logic Operations.
3	To study and perform Programmable Logic Controllers ON/OFF Control Using Ladder Logic Diagram.
4	To study and interface HMI with PLC.
5	To study and perform conveyor motor and speed control using PLC.
6	To study and perform water level control using PLC.
7	To study and perform AC motor speed control with VFD using PLC.
8	To study and perform conveyor based color sorting module control using PLC.
9	To study and perform star delta connection of AC motor using PLC.
10	To study and perform four way traffic control using PLC.
11	Develop, Simulate and Test Ladder diagram for Car Parking system.
12	Develop Simulate and Test Ladder diagram for Binary to Gray code.
13	Develop Simulate and Test Ladder diagram for Bottle Filling system.
14	To study PLC timer and counter based application using Ladder Logic Diagram.
15	To study DCS and SCADA

(2)

- 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	Demonstrate a comprehensive understanding of the basic principles and fundamental concepts governing hydraulic and pneumatic systems, including fluid properties, Pascal's Law, and Boyle's Law.
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CLOBJ 2	Identify, describe, and explain the functions of key components in hydraulic and pneumatic systems, such as pumps, valves, actuators, and control elements, and analyze their roles in system operation.
CLOBJ 3	Apply principles of fluid power to design and analyze hydraulic and pneumatic systems, considering factors such as system efficiency, power transmission, safety, and environmental impact.
CLOBJ 4	Develop skills in diagnosing and troubleshooting common issues in hydraulic and pneumatic systems, and apply appropriate maintenance practices to ensure system reliability and longevity.
CLOBJ 5	Understand and adhere to safety standards and regulations related to hydraulic and pneumatic systems, demonstrating the ability to design systems with safety in mind and implement proper safety measures.

f. Course Learning Outcomes:

CLO 1	To understand the knowledge about hydraulic and pneumatic systems.
CLO 2	To control motions through hydraulic and pneumatic systems.
CLO 3	To understand behaviour of working media in hydraulic and pneumatic systems.
CLO 4	To do automation by integrating electrical and mechanical components in hydraulic and pneumatic systems.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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	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 it's 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, count application, automatic cylinder reciprocating, fail safe circuit, pump unloading circuits, Power losses in flow control circuits.	12%	5
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%	3
	Total	100	45

i. Text Book and Reference Book:

1. Basic Pneumatic Systems, Principle and Maintenance, By S R Majumdar | McGraw-Hill
2. Hydraulics & Pneumatics, By Andrew Parr, | Jaico Publications
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. Techn; Iliffe
5. Oil Hydraulic Systems, By S R Majumdar, | Tata McGraw-Hill
6. Industrial Hydraulics, By John Pippenger & Taylor Hicks | McGraw-Hill

a. Course Name: Hydraulic and Pneumatic Systems Lab

b. Course Code: 303122352

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	Gain a fundamental understanding of the principles governing hydraulic and pneumatic systems, including fluid mechanics, Pascal's law, Boyle's law, and the operation of components such as pumps, valves, cylinders, and actuators.
CLOBJ 2	Learn how to design, analyze, and select hydraulic and pneumatic systems for specific applications, considering factors such as load requirements, pressure ratings, flow rates, and efficiency.
CLOBJ 3	Develop practical skills in assembling, disassembling, and troubleshooting hydraulic and pneumatic circuits and systems, including identifying and rectifying common faults and malfunctions
CLOBJ 4	Understand and adhere to safety procedures and best practices when working with hydraulic and pneumatic systems, including handling high-pressure fluids, securing hoses and fittings, and implementing emergency shutdown procedures.

CLOBJ 5	Learn how to measure and control pressure, flow rate, and other parameters in hydraulic and pneumatic systems using instruments such as pressure gauges, flow meters, and control valves.
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f. Course Learning Outcomes:

CLO 1	Demonstrate a thorough understanding of the fundamental principles governing hydraulic and pneumatic systems, including fluid properties, Pascal's Law, Boyle's Law, and Bernoulli's Principle.
CLO 2	identify, analyze, and solve problems encountered in hydraulic and pneumatic systems, employing systematic troubleshooting techniques and critical thinking skills.
CLO 3	Develop practical skills through hands-on experience with assembling, disassembling, and testing hydraulic and pneumatic circuits and systems in a laboratory setting.
CLO 4	design, analyze, and troubleshoot hydraulic and pneumatic circuits, considering factors such as flow rate, pressure, force, and energy efficiency.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	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.

(3)

- a. **Course Name:** Power Electronics
- b. **Course Code:** 303122353
- c. **Prerequisite:** Basic knowledge of Electronic Devices and circuits and Electric fundamentals.
- d. **Rationale:** The subject is useful for the students of robotics to apply knowledge for constructing applications based on Robotics.
- e. **Course Learning Objective:**

CLOBJ 1	Proficient understanding and application of power semiconductor devices in electronic circuits.
CLOBJ 2	Ability to analyse, design, and optimize diverse power converters for energy conversion.
CLOBJ 3	Competence in implementing control strategies, including feedback and PWM, for effective power electronics system regulation.
CLOBJ 4	Practical knowledge of applying power electronics in various industries, such as renewable energy and electric vehicles.
CLOBJ 5	Skills to identify, assess, and resolve challenges related to power quality and thermal management in power electronic systems.

f. Course Learning Outcomes:

CLO 1	Understand power semiconductor devices and their characteristics.
CLO 2	Analyse and design various power converters for efficient energy conversion.
CLO 3	Explore control strategies, including feedback and PWM, for power electronics systems.
CLO 4	Examine practical applications of power electronics in industries like renewable energy and electric vehicles.
CLO 5	Evaluate and address challenges such as power quality and thermal management in power electronic systems.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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	Content	Weightage	Teaching Hours
1	Thyristors and their Characteristics Introduction to thyristor family V-I characteristics of SCR, SUS, PUT, SCS, GTO, LASCR, DIAC and TRIAC. Principle of operation of SCR. Two transistor analogy. Turn on methods of a thyristor Switching characteristics of thyristors during turn-on and turn-off. Gate characteristics. Firing of thyristors. Gate triggering circuits. Series and parallel, operation of SCRs and their triggering circuits. Thyristor specifications; such as latching current and holding current, dv/dt and di/dt , PTV etc. Protection of SCR from over voltage and over current. Snubber circuits. Power dissipation. 22 10	22%	10
2	Thyristor commutation Techniques Load commutation (Class A), Resonant-Pulse commutation (class B), impulse commutation (class D), Line commutation (class F).	10%	4
3	Phase Controlled Techniques Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and full controlled bridge rectifiers. Three phase full controlled bridge rectifiers. Effect of resistive, inductive and resistive conductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and noncirculating current mode of operation. Applications of rectifiers and dual converters to speed control of DC motor drives	20%	9

4	Choppers Introduction and principle of chopper operations. Control strategies, two quadrant chopper, Four quadrant chopper. Regenerative chopper. Steady state time domain analysis of type A-chopper, voltage commutated chopper or classical Jones chopper. Applications of Choppers to speed control of DC motor drives.	15%	6
5	Cyclo converters Basic circuit and operation of single phase cyclo converter. Single phase bridge cyclo converter. Three phase to single phase to single phase cyclo converter. Advantages disadvantages of cyclo converters. Applications of Cyclo converters for Drives	15%	7
6	Inverters Introduction to inverter. Operating principle and already state analysis of single phase, voltage source, bridge inverter. Modified McMurray half bridge and full bridge inverter. Three phase bridge inverter. Voltage control (PWM control etc.) and reduction of harmonics in the inverter output voltage. Series inverter. Inverter Applications to AC Motor Drives	18%	9
	Total	100	45

i. Text Book and Reference Book:

1. Power Electronics By Dr. P S Bimbhra | Khanna Publisher
2. Power electronics By M D Singh and K B Khanchandani | Tata MacGraw Hill
3. Modern Power Electronics and AC Drives By Bimal. K. Bose | Pearson Education
4. Power Electronics - Circuits, Devices and Applications By Muhammad H. Rashid | Prentice Hall of India
5. Modern Power Electronics By P C Sen | S.Chand | 1/e, Pub. Year 1998

a. Course Name: Power Electronics Lab

b. Course Code: 303122354

c. Prerequisite: Basic knowledge of Electronic Devices and circuits and Electric fundamentals.

d. Rationale: The subject is useful for the students of robotics to apply knowledge for constructing applications based on Robotics.

e. Course Learning Objective:

CLOBJ 1	Understand the operation and characteristics of various power electronic devices such as diodes, thyristors, MOSFETs, IGBTs, and their applications in power conversion circuits.
CLOBJ 2	Design, simulate, and analyze power electronic circuits for rectification, inversion, chopper control, and voltage regulation using appropriate software tools and mathematical techniques.
CLOBJ 3	Implement control strategies such as PWM (Pulse Width Modulation) and feedback control techniques to regulate voltage, current, and power in power electronic systems.
CLOBJ 4	Measure and evaluate performance parameters including efficiency, power factor, harmonic distortion, and transient response of power electronic systems under different operating conditions.
CLOBJ 5	Identify, troubleshoot, and rectify faults and issues in power electronic circuits and systems using systematic troubleshooting methodologies and instrumentation.

f. Course Learning Outcomes:

CLO 1	Analyze the performance characteristics of power electronic systems through practical experimentation, including efficiency, harmonic distortion, voltage regulation, and transient response.
CLO 2	Apply systematic troubleshooting techniques to identify and rectify faults in power electronic circuits, ensuring reliable and efficient operation.
CLO 3	Develop critical thinking skills to analyze complex power electronic problems, develop appropriate solutions, and adapt strategies based on experimental outcomes.
CLO 4	Demonstrate the ability to design, assemble, and test power electronic circuits for various applications including rectification, inversion, and voltage regulation.
CLO 5	Design, simulate, and construct power electronic circuits for various applications including rectification, inversion, and conversion of electrical power.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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	To study principle of operation of SCR, plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2	To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator.
3	To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
4	To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
5	Study of the microprocessor-based firing control of a bridge converter.
6	To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles
7	Study of Jones chopper or any chopper circuit to check the performance.
8	Thyristorised speed control of a D.C. Motor.
9	Speed Control of induction motor using thyristors.
10	Study of series inverter circuit and to check its performance.
11	Study of a single-phase cycloconverter.
12	To check the performance of a Mc Murray half-bridge inverter.

(4)

- a. **Course Name:** Micro and Smart Systems Technology Theory
- b. **Course Code:** 303122355
- c. **Prerequisite:** Knowledge of electrical engineering, physics, or a related field. Proficiency in programming, knowledge of control systems, and a solid understanding of electronics are essential.
- d. **Rationale:** The purpose of this course is to have interdisciplinary nature of micro and smart system technology makes it a key driver for advancements in filed like electronics, robotics and sensor networks.
- e. **Course Learning Objective:**

CLOBJ 1	Understand the basic principles and concepts underlying microsystems and smart systems.
CLOBJ 2	Learn various microfabrication techniques used in the production of microsystems.
CLOBJ 3	Design and implement simple sensor-actuator systems for specific tasks.
CLOBJ 4	Learn control strategies for managing and optimizing micro and smart systems.

CLOBJ 5	Analyse case studies to understand the challenges and solutions in implementing micro and smart technologies.
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f. Course Learning Outcomes:

CLO 1	To grasp the principles and applications of micro and smart systems.
CLO 2	To gain practical experience in microfabrication techniques in a cleanroom setting.
CLO 3	To skilled in selecting, integrating, and troubleshooting sensors and actuators for microsystems.
CLO 4	To design and implement embedded systems for effective control of micro and smart systems.
CLO 5	To critically assess applications, considering societal and ethical implications of micro and smart system technologies.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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	Content	Weightage	Teaching Hours
1	Introduction to Micro and Smart systems: Miniaturization, Microsystems versus MEMS, Micro-fabrication, Smart Materials, Structures & Systems, Integrated Microsystems, Application of Smart Materials & Microsystems.	26%	10
2	Micro and Smart Devices and Systems: Principles and Materials: Definitions and salient features of sensors, actuators, and systems. Sensors: silicon capacitive accelerometer, piezo resistive pressure sensor, Portable blood analyser,	24%	9

	conduct metric gas sensor. Actuators: Micro mirror Array for Video Projection, Piezoelectric based inkjet print head, electrostatic comb-drive, and Magnetic micro relay.		
3	Micromachining Technologies: Silicon as a Material for Micromachining, Silicon wafer preparation, thin-film deposition techniques, Lithography, Etching, Silicon micromachining: surface micromachining, bulk micromachining. Specialized Materials for Microsystems.	20%	9
4	Electronics Circuits for Micro and Smart Systems: Semiconductor devices: Diode, Schottky diode, Tunnel diode, BJT , MOSFET, CMOS circuits ,Electronics Amplifiers, Op-Amp based circuits .	14%	7
5	Implementation of Controllers for MEMS & Case Studies of Integrated Microsystems: Design Methodology, PID controller, Circuit Implementation, Digital controller, Microcontroller & PLC. Case Studies of Integrated Microsystems: BEL pressure sensor; design considerations, performance parameters, and Smart Structure in vibration control.	16%	10
	Total	100	45

i. Text Book and Reference Book:

1. Micro and Smart Systems, G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat, V.K.Aatre, Wiley India
2. Design and Development Methodologies, Smart Material, V. Varadan, K. J. Vinoy,S. Gopalakrishnan, Wiley
3. MEMS , Nitaigour Premchand Mahalik, Tata Mc-Graw-Hill
4. MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill

a. Course Name: Micro and Smart Systems Technology Theory Lab

b. Course Code: 303122356

c. Prerequisite: Knowledge of electrical engineering, physics, or a related field. Proficiency in programming, knowledge of control systems, and a solid understanding of electronics are essential.

d. Rationale: The purpose of this course is to have interdisciplinary nature of micro and smart system technology makes it a key driver for advancements in filed like electronics, robotics and sensor networks.

e. Course Learning Objective:

CLOBJ 1	Understand the basic principles and concepts underlying microsystems and smart systems.
CLOBJ 2	Analyse the different electronics component properties
CLOBJ 3	Design and implement simple sensor-actuator systems for specific tasks.
CLOBJ 4	Simulate and develop different circuit using various component.
CLOBJ 5	Design hardware circuit from electronics component

f. Course Learning Outcomes:

CLO 1	To learn the principles and applications of micro and smart systems.
CLO 2	Learn practical experience in micro fabrication techniques in a cleanroom setting.
CLO 3	To skilled in selecting, integrating, and troubleshooting sensors and actuators for microsystems.
CLO 4	To design and implement embedded systems for effective control of micro and smart systems.
CLO 5	To critically assess applications, considering societal and ethical implications of micro and smart system technologies.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	2	1	0	0	20	0	30	50

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 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.

(5)

- a. Course Name** Employability Skills
- b. Course Code:** 203193353
- c. Prerequisite:** Basic knowledge of ethics, corporate etiquettes and understanding of the fundamentals of communication are essential.
- d. Rationale:** Interpersonal skills and ethics are essential for placement
- 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

(6)

a. Course Name: Minor Project

b. Course Code: 303122358

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:

CLOBJ 1	Understand project life cycle phases and apply scheduling methodologies for engineering projects.
CLOBJ 2	Manage resources effectively while mitigating risks and ensuring quality standards in engineering project deliverables.
CLOBJ 3	Foster teamwork, communication, and leadership skills for diverse stakeholders within project contexts.
CLOBJ 4	Create comprehensive project documentation and reports, adhering to ethical standards and professional responsibilities.
CLOBJ 5	Apply technical knowledge, interdisciplinary approaches, and continuous improvement strategies in engineering project management.

f. Course Learning Outcomes:

CLO 1	Use and apply information from technical literature, Identify and set clearly the aims and objectives of research project.
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CLO 2	Develop a research proposal and plan for a research project in an appropriate area relevant to the programme of study.
CLO 3	Source and critically review literature relevant to a chosen project topic.
CLO 4	Evaluate a range of data analysis methods, experimental methods, alternative approaches in relation to specific project objectives.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	12	6	-	-	100	-	100	200

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

(7) PEC 02

- a. Course Name:** Real time embedded system
- b. Course Code:** 303122381/303122382
- c. Prerequisite:** Computer Architecture/Organization, Operating systems, programming knowledge.
- d. Rationale:** Tiny operating systems are available in many appliances/devices. While operating systems govern the hardware, real time operating systems help to ease the tasks. It is good for under graduates of computer engineers to learn the Processor level details for real time systems, basic architectures, primitive programming, understand the given real time system
- e. Course Learning Objective:**

CLOBJ 1	Define what an embedded system is and understand its characteristics. Differentiate between general-purpose computing systems and embedded systems.
CLOBJ 2	Define real-time systems and understand the importance of timing constraints. Differentiate between hard real-time and soft real-time systems.
CLOBJ 3	Understand the architecture of microcontrollers/microprocessors commonly used in embedded systems.

CLOBJ 4	Explore real-time operating systems (RTOS) and their role in managing tasks in embedded systems.
CLOBJ 5	Understand communication protocols commonly used in real-time embedded
CLOBJ 6	Gain practical experience in designing real-time embedded systems.

f. Course Learning Outcomes:

CLO 1	Understand the hardware and software components of an Embedded devices that are used in daily life.
CLO 2	Design the typical building blocks of an Embedded System
CLO 3	Develop an ability to design a system to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability and sustainability

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	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 -Embedded Systems Overview, Design Challenge Optimizing Design Metrics, Processor Technology, IC Technology, Design Technology, Trade-offs	15%	7
2	Custom Single-Purpose Processors Hardware-Introduction, Combinational Logic, Sequential Logic, Custom Single-Purpose Processor Design, RT-Level Custom Single- Purpose Processor Design, Optimizing Custom Single-Purpose Processors	15%	7

3	Standard Single-Purpose Processors Peripherals- Introduction, Timers, Counters, and Watchdog Timers, UART, Pulse Width Modulators, LCD Controllers, DMA Controllers, Keypad Controllers, Stepper Motor Controllers, Analog-to-Digital Converters, RealTime Clocks	20%	9
4	Designing Embedded Computing Platform Common Memory Types, Composing Memory, Memory Hierarchy an Cache, Advanced RAM. Microprocessor Interfacing: I/O Addressing Interrupts and Direct Memory Access, Arbitration, Multilevel Bus Architectures, Advanced Communication Principles, Serial Protocols, Parallel Protocols, I2C, CAN Bus; I/O Device Interfacing Protocols- GPIB, FIREWIRE, USB, IRDA	20%	9
5	Computer System Architecture Bus Protocols and Organization-PCI, ISA, EISA, CISC and RISC processor, Harvard and Von Neumann Architecture, Superscalar and VLIW architectures; Introduction to ARM Processor	15%	6
6	Real Time Operating System Real time concepts, real time operating systems, Required services/capabilities, Resource Management/scheduling paradigmatic priorities, static schedules, dynamic scheduling, Priority in the protocol, Priority ceiling protocol	15%	7
	Total	100	45

i. Text Book and Reference Book:

1. Computer as Components: Principles of Embedded Computing System Design, By Wayne Wolf, | Morgan Kaufmann Publication.
2. Embedded systems Architecture, Programming and Design By Rajkamal | TMH
3. Embedded System Design : A Unified Hardware Software introduction By Frank Wahid, & Tony Givargis | John Wiley India
4. Specification and Design of Embedded Systems By D. Gajski, F. Vahid, S.Narayan, and J. Gong | Prentice Hall
5. Hardware Software Co -design: Principles and Practice By JorganSyaunstrup and W.Wolf | Springer
6. Programming Embedded Systems in C and C++ By Michael Barr | O'Reilly Media,, Pub. Year 1999
7. RTS: Real-Time Systems By C.M. Krishna and Kang G. Shin | McGraw-Hill
8. Advances in Hard Real-Time Systems By J. A. Stankovic and K. Ramamritham | IEEE Computer Society Press, Washington DC

a. Course Name: Real time embedded system Lab

b. Course Code: 303122382

- c. **Prerequisite:** Computer Architecture/Organization, Operating systems, programming knowledge.
- d. **Rationale:** Tiny operating systems are available in many appliances/devices. While operating systems govern the hardware, real time operating systems help to ease the tasks. It is good for under graduates of computer engineers to learn the Processor level details for real time systems, basic architectures, primitive programming, understand the given real time system

e. Course Learning Objective:

CLOBJ 1	Learn programming techniques for real-time embedded systems, including low-level programming, interrupt handling, and device driver development.
CLOBJ 2	Understand how to integrate hardware and software components to create a functioning embedded system that meets real-time requirements.
CLOBJ 3	Develop skills in identifying, analyzing, and solving problems that arise in real-time embedded systems, including debugging techniques and fault tolerance.
CLOBJ 4	Learn how to effectively document and report on the design, implementation, and testing of real-time embedded systems.
CLOBJ 5	Develop practical skills in designing, implementing, and testing real-time embedded systems using microcontrollers or other embedded platforms.
CLOBJ 6	Gain a practical understanding of real-time systems, including concepts such as task scheduling, timing constraints, and system responsiveness.

f. Course Learning Outcomes:

CLO 1	Evaluate the effectiveness of a given real-time system design.
CLO 2	Design a real-time embedded system to meet specified requirements.
CLO 3	Integrate software and hardware components to implement a functional real-time system

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme		
L	T	P	C	Internal Evaluation	ESE	Total

				MSE	CE	P	Theory	P	
0	0	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. Experiment List :

Sr. No.	Experiment List
1	Give Specification of anyone of the Embedded Systems with its UML diagram.
2	Using Logisim Simulation Tool, Design Full Adder and XNOR gate. And also specify its truth table.
3	Design a Circuit for computing Fibonacci numbers up to 1000 and simulate the operation.
4	Design 7 segment LED using Combinational Analysis Option of Logisim Simulator.
5	Explore GCC compiler options (processor and optimization) and analyze the code size for various optimization options.
6	Study MAKE command of UNIX and write a C program of calculator with few basics functions defined in separate file. Use MAKE command to generate executable
7	Study and Perform TAR, GPROF, PROF Commands.
8	Write a Matrix multiplication program without using array Data Structure.
9	Implement GCD using Logisim Simulator.
10	Write an 8051 C program to toggle all the bits of P0 and P2 continuously with 250 ms delay.

a. Course Name: VLSI Design

b. Course Code: 303122383

c. Prerequisite : Computer Architecture/Organization, Operating systems, programming knowledge.

d. Rationale: Tiny operating systems are available in many appliances/devices. While operating systems govern the hardware, realtime operating systems help to ease the

tasks. It is good for under graduates of computer engineers to learn the Processor level details for real time systems, basic architectures, primitive programming, understand the given real time system.

e. Course Learning Objective:

CLOBJ 1	Define VLSI and understand the significance of integrating thousands to millions of transistors on a single chip. Learn about the historical development of VLSI technology.
CLOBJ 2	Understand semiconductor physics and the operation of fundamental electronic devices (transistors, diodes) used in VLSI circuits.
CLOBJ 3	Learn digital system design principles and Boolean algebra. Understand how to represent and manipulate digital signals using logic gates.
CLOBJ 4	Study Complementary Metal-Oxide-Semiconductor (CMOS) technology, which is widely used in VLSI design.
CLOBJ 5	Learn about different design abstraction levels, including behavioral, register-transfer, gate-level, and physical design.
CLOBJ 6	Gain proficiency in using HDLs such as Verilog or VHDL for specifying and simulating digital circuits.

f. Course Learning Outcomes:

CLO 1	Design digital systems using hardware description languages required for VLSI Design such as VHDL.
CLO 2	Learn how to program and test programs on FPGAs or CPLD.
CLO 3	Get exposure to the Various Digital Design Issues, ASIC Technology and Design techniques.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	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 ASIC Design flow, Design Methodologies, Hardware modelling issues, Overview of FPGA and CPLD technology.	10%	5
2	Hardware Description Language Elements of VHDL, Entity, architecture, configuration declaration. Identifiers, data types and operators, Assignment statement, Objects in VHDL signals, variables, constants, files, Attributes of objects.	10%	5
3	Behavioural Modelling Process statement, Signal and variable assignment, Wait statement, if statement, Case statement, Loops, exit, and next statement, Assertion and report statement, Multiple process, Postponed process. Subprograms procedures and functions, Subprogram overloading and operator overloading. RTL description.	15%	6
4	Dataflow Modelling Concurrent signal assignment, sequential signal assignment, delta delay, multiple drivers, conditional signal assignment using when else, selected signal assignment using with select, block statement, concurrent assertion signal.	15%	6
5	Structural Modelling Component declaration, generics and component instantiation, Example of making hierarchical circuit. Generate statement, aliases, mixed modelling style.	15%	7
6	Finite State Machine State diagrams and state tables, Moore and Mealy finite state machine, encoding style, FSM issues, Timing issues, pipelining, resource sharing, metastability, synchronization, MTBF Analysis, setup/hold time of various types of flip - flops, synchronization between multiple clock domains, reset recovery.	15%	7
7	Programmable Logic Design Basics of Programmable logic devices-PROM, PAL, PLA, etc, CPLD architecture and its building blocks, FPGA architectures and its building blocks, Carry chains in FPGA, Dedicated multipliers and memory in FPGA, RTL synthesis test methodology, Design synthesis, Technology mapping for FPGAs: SRAM, Fuse, Antifuse, EPROM programming techniques. Design implementation using CPLD and FPGA, Floor planning, Placement and routing	20%	9

	Total	100	45
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i. Text Book and Reference Book:

1. VHDL programming by examples By .Douglas L. Perry | Tata McGraw Hill | 4TH
2. VHDL Primer By J. Bhasker | Pearson Education Asia
3. Principles of Digital Systems Design using VHDL By Charles H Roth, | Cengage Learning
4. VHDL for programmable logic By Kevin Skahill | Pearson Education Asia
5. Application Specific Integrated Circuits By Michael John Sebastian Smith | Pearson Education
6. Digital Design Principles & Practices By John F. Wakerly | Prentice Hall International, Inc | Third edition

a. Course Name: VLSI Design Lab

b. Course Code: 303122384

c. Prerequisite : Computer Architecture/Organization, Operating systems, programming knowledge.

d. Rationale: Tiny operating systems are available in many appliances/devices. While operating systems govern the hardware, realtime operating systems help to ease the tasks. It is good for under graduates of computer engineers to learn the Processor level details for real time systems, basic architectures, primitive programming, understand the given real time system.

e. Course Learning Objective:

CLOBJ 1	Learn digital circuit design techniques for VLSI, including logic gates, flip-flops, registers, and arithmetic circuits.
CLOBJ 2	Develop practical skills in using industry-standard EDA (Electronic Design Automation) tools for VLSI design, simulation, and verification.
CLOBJ 3	gain hands-on experience in designing and implementing circuits on Field-Programmable Gate Arrays (FPGAs), including synthesis and place-and-route.
CLOBJ 4	Learn digital circuit design techniques for VLSI, including logic gates, flip-flops, registers, and arithmetic circuits.
CLOBJ 5	understand the basics of analog circuit design for VLSI, including amplifiers, comparators, and other analog building blocks.
CLOBJ 6	Learn about Application-Specific Integrated Circuit (ASIC) design techniques, including standard cell design, ASIC libraries, and design for testability (DFT).

f. Course Learning Outcomes:

CLO 1	Develop proficiency in using Electronic Design Automation (EDA) tools for VLSI design, simulation, and verification.
CLO 2	Learn how to perform timing analysis and optimize designs for timing constraints.
CLO 3	Develop problem-solving and critical thinking skills in the context of VLSI design challenges.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	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. Experiment List :

Sr. No	Experiment List
1	Design 4-bit Binary to Gray code converter. (b)Design 4-bit Gray to Binary code converter.
2	Design 9-Bit Parity Generator.
3	(a)Design Half Adder circuit using Behavioural , Structure and Data flow model. (b) Design Full Adder circuit using Behavioural, Structure and Data flow model.
4	(a)Design 4 x 1 MUX circuit using Behavioural , Structure and Data flow model. (b) Design 8 x 1 MUX circuit using Behavioural, Structure and Data flow.
5	(a)Design 16 x 1 MUX circuit using when...else statement. (b) Design 16 x 1 MUX circuit using case statement.
6	(a)Design 16 x 1 MUX circuit using when...else statement. (b) Design 16 x 1 MUX circuit using case statement
7	(a) Design rising edge D flip flop. (b) Design falling edge D flip flop.
8	(a) Design a JK flip flop. (b)Design a JK flip flop using a D flip flop.

9	To Perform 8-BIT Shift Left/Shift Right Register with Positive Edge, Serial In Parallel Out.
10	Construct BCD to 7- Segment Converter.
11	Design UP-Down Counter that count UP if DIR is high and count DOWN if DIR is low.

- a. Course Name:** Wireless communication
- b. Course Code:** 303122385
- c. Prerequisite :** Higher Engineering Mathematics, Fundamental knowledge of Signals and Systems, Digital Communication theory, Probability and random processes, Programming skills in Simulation Exercises.
- d. Rationale:** The purpose of this course is to provide an understanding of modern Digital mobile and wireless communication systems. Also give knowledge of recent trends in the field of wireless communication.
- e. Course Learning Objective:**

CLOBJ 1	Define wireless communication and understand its importance in modern communication systems.
CLOBJ 2	Understand the characteristics of the wireless channel, including path loss, shadowing, and multipath fading.
CLOBJ 3	Study various modulation techniques used in wireless communication, including amplitude modulation (AM), frequency modulation (FM), and digital modulation schemes.
CLOBJ 4	Understand multiple access techniques such as Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), and Orthogonal Frequency Division Multiple Access (OFDMA).
CLOBJ 5	Explore wireless networking protocols, including IEEE 802.11 (Wi-Fi), Bluetooth, Zigbee, and cellular communication standards (e.g., GSM, 3G, 4G, and 5G).
CLOBJ 6	Study antenna design principles and their role in wireless communication.

f. Course Learning Outcomes:

CLO 1	Design a mobile cellular network.
CLO 2	Select the apt diversity scheme for a given wireless system to improve the performance.
CLO 3	Propose a suitable multiple access techniques such as CDMA, and OFDM for spectral allocation.
CLO 4	Gain knowledge of underlying mobile standards and the future mobile technologies such as W -CDMA, Wi-Max, and also the upcoming 4G and 5G mobile standards

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	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 Wireless communication and Fading Cellular structure, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Interference and system capacity-Co Channel Interference reduction and system capacity, Adjacent Channel interference, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring, Mobile Antennas, Large scale path loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Small scale multipath propagation.	20%	9
2	Evolution of Mobile communication standards Second generation Cellular Networks, Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL), Wireless Local Area network(WLAN),	20%	9

	Bluetooth and Personal Area Networks, Overview of GSM, Introduction to CDMA, WCDMA, GPRS system architecture.		
3	Statistical Multipath Channel Models and Capacity of Wireless Channels Time-Varying Channel Impulse Response, Narrowband fading models, Discrete-Time Model, Wideband Fading Models.	15%	7
4	Diversity Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration- Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity.	15%	7
5	OFDM and MIMO Introduction to OFDM, Multicarrier Generation of sub-carriers using the IFFT OFDM signal processing and Transreceiver blocks; Peak Power Problem: PAPR reduction schemes, SNR performance, Introduction to MIMO.	15%	7
6	Advances in wireless Wi-Fi, Wi-MAX, Introduction to 4G-LTE & LTE Advanced and 5G standards, Cognitive radio.	15%	6
	Total	100	45

i. Text Book and Reference Book:

1. Wireless Communication By T.S.Rappaport | Pearson Edu.
2. Wireless Communications By Andrea Goldsmith | Cambridge University Press
3. "Wireless Communication" By Dalal Upena | Oxford Press, 1st Ed., 2009
4. MIMO Wireless Communications By Ezio Biglieri | Cambridge University
5. Principle and Application of GSM By V.K.Garg, J.E.Wilkes | Pearson Education | 5TH, Pub. Year 2008

a. Course Name: Wireless communication Lab

b. Course Code: 303122386

c. Prerequisite : Higher Engineering Mathematics, Fundamental knowledge of Signals and Systems, Digital Communication theory, Probability and random processes, Programming skills in Simulation Exercises.

d. Rationale: The purpose of this course is to provide an understanding of modern Digital mobile and wireless communication systems. Also give knowledge of recent trends in the field of wireless communication.

e. Course Learning Objective:

CLOBJ 1	understand the fundamental concepts and principles of wireless communication systems, including modulation, multiplexing, and signal propagation.
CLOBJ 2	Evaluate the performance of wireless networks under different conditions, such as varying distances, interference, and network loads
CLOBJ 3	Develop skills in using and configuring wireless devices such as routers, access points, and mobile devices for various communication scenarios.
CLOBJ 4	Use software tools to prototype and simulate wireless communication systems, allowing for experimentation and analysis in a controlled environment.
CLOBJ 5	Practice documenting lab experiments, results, and findings in a clear and concise manner, following standard reporting formats.
CLOBJ 6	Gain practical understanding of wireless communication systems, including modulation techniques, channel coding, and multiple access methods.

f. Course Learning Outcomes:

CLO 1	Evaluate the security vulnerabilities of a wireless network and propose solutions.
CLO 2	Assess the effectiveness of different wireless communication protocols in a given scenario.
CLO 3	Design and implement a wireless communication system to meet specific requirements.
CLO 4	Develop a plan to optimize the performance of a wireless network based on analysis results.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	0	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. Experiment List :

Sr. No.	Experiment List
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1	Perform various network commands for wired and wireless
2	Write a Program to Implement CDMA.
3	Prepared Ad-hoc network in Windows 10 and described all commands
4	Write a program to divide the given area and create clusters using given set of frequencies
5	Introduction to Android.
6	Program: Write a simple android program to print Hello World!
7	Display the form for user personal info when button click.
8	Create Android Application for Simple Calculator.
9	9 Implement Simple Login form in following layout. 1) Relative Layout, 2) Linear Layout, 3) Absolute Layout.
10	Case study of evolution of wireless communication

Semester 7

(1)

- a. **Course Name:** Field and Service Robots and Lab
- b. **Course Code:** 303122401, 303122402
- c. **Prerequisite:** Knowledge of Robot Kinematics and Dynamics
- d. **Rationale:** A course on field and service robots would be designed to provide individuals with the knowledge and skills necessary to understand, develop, and implement robotic systems tailored for specific applications in fields and service-oriented industries.
- e. **Course Learning Objective:**

CLOBJ 1	Design and implement robotic systems for specific applications, integrating mechanical, electrical, and software components.
CLOBJ 2	Develop proficiency in programming languages and control algorithms to enable autonomous navigation and human-robot interaction.
CLOBJ 3	Analyse industry requirements to customize robotic solutions, considering safety standards and ethical considerations.
CLOBJ 4	Demonstrate expertise in troubleshooting, maintenance, and data analysis for optimal robotic system performance.
CLOBJ 5	Collaborate interdisciplinary teams, communicate technical concepts effectively, and manage projects in the field of service robotics.

f. Course Learning Outcomes:

CLO 1	Understand the fundamental principles of robotics, including kinematics, dynamics, sensors, actuators, and control systems.
CLO 2	Learn the principles of mechanical design and engineering as they apply to the construction of field and service robots.
CLO 3	Understand how to integrate sensors for perception and environmental awareness, allowing robots to navigate, recognize objects, and respond to changing conditions.
CLO 4	Explore algorithms and strategies for autonomous navigation in dynamic and unstructured environments.

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 History of service robotics – Present status and future trends – Need for service robots – applications examples and Specifications of service and field Robots. Non-conventional Industrial robots	22%	10
2	LOCALIZATION Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization Monte Carlo localization Landmark based navigation-Globally unique localization-	33%	15

	Positioning beacon systems- Route based localization.		
3	PLANNING AND NAVIGATION Introduction-Path planning overview- Road map path planning- Cell decomposition path planning- Potential field path planning- Obstacle avoidance - Case studies: tiered robot architectures.	20%	9
4	FIELD ROBOTS Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.	15%	7
5	HUMANOIDS Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.	10%	4
	Total	100	45

i. Text Book and Reference Book:

1. Introduction to Autonomous Mobile Robots by Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, | Bradford Company Scituate, USA, 2004.
2. The future of Humanoid Robots- Research and applications By Riadh Siaer | Intech Publications, 2012.
3. Robotics Engineering – An Integrated Approach by Richard D Klafter, Thomas A Chmielewski, Michael Negin, | Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
4. Field and Service Robotics By Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew | Springer, 2011

j. Experiment List :

Sr. No	Experiment List
1	Need for service robot.
2	Experiment on robot kinematics
3	Probabilistic Map based Localization-Monte Carlo localization.
4	Global & Local path planning in robotics.

5	Assignment on Metrical maps - Grid maps - Sector maps – Hybrid Maps.
6	Case study on Human activity recognition using vision, touch, sound etc.

(2)

- a. **Course Name:** Project – I
- b. **Course Code:** 303122408
- 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:

CLOBJ 1	Understand project life cycle phases and apply scheduling methodologies for engineering projects.
CLOBJ 2	Manage resources effectively while mitigating risks and ensuring quality standards in engineering project deliverables.
CLOBJ 3	Foster teamwork, communication, and leadership skills for diverse stakeholders within project contexts.
CLOBJ 4	Create comprehensive project documentation and reports, adhering to ethical standards and professional responsibilities.
CLOBJ 5	Apply technical knowledge, interdisciplinary approaches, and continuous improvement strategies in engineering project management.

f. Course Learning Outcomes:

CLO 1	Use and apply information from technical literature, Identify and set clearly the aims and objectives of research project.
CLO 2	Develop a research proposal and plan for a research project in an appropriate area relevant to the programme of study.
CLO 3	Source and critically review literature relevant to a chosen project topic.
CLO 4	Evaluate a range of data analysis methods, experimental methods, alternative approaches in relation to specific project objectives.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	12	6	-	-	100	-	100	200

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

- a. Course Name:** Summer Internship – II
- b. Course Code:** 303122406
- 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:**

CLOBJ 1	Apply engineering principles to solve real-world problems during the internship.
CLOBJ 2	Gain hands-on experience in engineering practices and methodologies within an industry setting.
CLOBJ 3	Develop professional communication and teamwork skills in an engineering work environment.
CLOBJ 4	Demonstrate adaptability and learning agility in tackling engineering challenges during the internship.
CLOBJ 5	Acquire practical knowledge and skills that align with industry standards and expectations in engineering.

f. Course Learning Outcomes:

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

g. Teaching & Examination Scheme:

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

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

(3)

PEC 03

- Course Name:** Internet of things
- Course Code:** 303122431,203122432
- Prerequisite:** Fundamentals of Embedded system, Wireless Communication, internet technology.
- 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 cover components of the networking and how to connect devices with internet.
- Course Learning Objective:**

CLOBJ 1	Define the Internet of Things and explain its fundamental concepts.
CLOBJ 2	Describe the architecture of IoT systems, including edge devices, communication protocols, and cloud infrastructure.

CLOBJ 3	Familiarize with communication protocols commonly used in IoT, such as MQTT, CoAP, and HTTP.
CLOBJ 4	Identify and evaluate various hardware components used in IoT devices.
CLOBJ 5	Recognize the security challenges in IoT and understand strategies for securing IoT devices and networks.

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					
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	Internet of Things (IoT) 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, Case	15%	7

	Study of Refrigerator, IoT Devices, IoT Devices vs. Computers, Societal Benefits of IoT, Risks, Privacy, and Security.		
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. M2M to IoT- An Architectural Overview	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.	15%	7
4	Hardware and Software Arduino Board : Arduino Platform, Arduino IDE, Compiling Code, Arduino Shields, Arduino Basic Setup & Interface, Sensor Technology: Light Sensor, Temperature Sensor, Sound Sensor, Touch Sensor, Smoke/ Gas Sensor, Smart Relay, Motion Sensor, IR Sensor, Flex Sensor. Raspberry Pi: About the board, Raspberry Pi Interfaces, Serial, SPI, Programming Raspberry Pi, Controlling LED with Raspberry Pi, Interfacing Switch, Light sensor (LDR) 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,	15%	7

	SMARTIE Approach. Data Aggregation for the IoT in Smart Cities, Security		
	Total	100	45

i. Text Book and Reference Book:

1. Introduction to Autonomous Mobile Robots by Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, | Bradford Company Scituate, USA, 2004.
2. The future of Humanoid Robots- Research and applications By Riadh Siaer | Intech Publications, 2012.
3. Robotics Engineering – An Integrated Approach by Richard D Klafter, Thomas A Chmielewski, Michael Negin, | Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
4. Field and Service Robotics By Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew | Springer, 2011

j. Experiment List :

Sr. No.	Experiment List
1	Introduction of Arduino Board.
2	Interface and toggle LED with Arduino UNO
3	Interface Buzzer with Arduino UNO
4	Interfacing of infrared sensor, and remote to control LEDs
5	Interfacing of Sound Sensor Detect a knocking sound and toggle the LED.
6	Interfacing of Capacitive Touch Sensor
7	Interfacing MQ-2 smoke / Gas sensor with Arduino
8	Read out the temperature with theTMP36 sensor and display the temperature on the serial monitor.
9	To control the stepper motor and turn around back and forth.
10	Introduction and working of Raspberry Pi Board.
11	Interfacing Raspberry Pi board with LED.
12	Interfacing Light Dependent Resistor LDR in Raspberry Pi
13	Interfacing DS18B20 Temperature sensor with Raspberry Pi
14	To create a database & store the value in Raspberry Pi
15	Case Study of IoT Project & OEP

a. Course Name: Digital Signal Processing and Applications

b. Course Code: 303122433/303122434

c. Prerequisite : Knowledge of Mathematics and signals and systems.

d. Rationale: The course provides the concept of analysing discrete time signals & systems in the time and frequency domain.

e. Course Learning Objective:

CLOBJ 1	Define signals and systems and understand the basic concepts of signal processing.
CLOBJ 2	Learn the fundamentals of sampling and quantization in the context of digital signals.
CLOBJ 3	Understand the DFT and its relationship to the Fourier Transform.
CLOBJ 4	Learn about the design and implementation of digital filters, including FIR (Finite Impulse Response) and IIR (Infinite Impulse Response) filters. Understand the design methods and trade-offs in filter design.
CLOBJ 5	Explore various filtering techniques, including low-pass, high-pass, band-pass, and band-stop filters.
CLOBJ 6	Study time-frequency analysis techniques such as the Short-Time Fourier Transform (STFT) and the spectrogram.

f. Course Learning Outcomes:

CLO 1	Classify signals and systems & their mathematical representation.
CLO 2	Analyse the discrete time systems.
CLO 3	Discuss and perform various transformation techniques & their computation.
CLO 4	Describe sampling and reconstruction of the signals.
CLO 5	Prepare FFT algorithms.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	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
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1	Discrete Time Signals and Systems, Application of Z-transform for the analysis of LTI system: Discrete time signals, Discrete time systems, Analysis of Discrete time linear time invariant systems, Discrete time systems described by difference equations, Implementation of Discrete time systems, Correlation of Discrete time signals, The z-transform, properties of z-transform, rational z-transform, Inversion of z-transform, Analysis of linear time invariant systems in z-domain, The one sided z-transform. Problems.	22%	10
2	Frequency Domain Analysis of LTI System: Frequency domain characteristics of linear time invariant systems, Frequency response of LTI systems. Convolution of LTI systems.	16%	7
3	Sampling and Reconstruction of Signals: Ideal sampling and reconstruction of continuous time signals, Discrete time processing of continuous time signals, Analog to digital and digital to analog converters, Sampling and reconstruction of continuous time band pass signals, Sampling discrete time signals.	16%	7
4	The Discrete Fourier Transform: Its Properties & Applications: Frequency domain sampling: the discrete Fourier transform, properties of DFT, linear filtering methods based on the DFT, frequency analysis of signal using the DFT.	18%	8
5	Implementation of Discrete Time Signals: Structures for the realization of the discrete time systems, structures for the FIR systems, structures for the IIR systems.	16%	7
6	FFT Algorithm: Efficient computing of the DFT: FFT algorithm, application of FFT algorithms.	12%	6
	Total	100	45

i. Text Book and Reference Book:

1. "Digital Signal Processing: Principles, Algorithms, & Applications", (TextBook) By Proakis, J.G., & Manolakis, D.G., | Prentice Hall of India.
2. "Digital Signal Processing: A Computer-Based Approach", By Mitra, S.K., | McGraw Hill, NY.
3. Digital Signal Processing By Anand Kumar | PHI

j. Experiment List :

Sr. No.	Experiment List
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1	MATLAB Code and Plot DFT of a given sequence without using the inbuilt MATLAB function.
2	MATLAB Code and Plot IDFT of a sequence without using the inbuilt MATLAB function. 3. 4.
3	Write a MATLAB Code and Plot Circular Convolution of given sequences Using MATLAB function.
4	MATLAB Code to apply FFT on a given sequence and plot the magnitude and phase response of the same.
5	Write a MATLAB Code to apply IFFT on a given sequence and plot the magnitude and phase response of the same.
6	MATLAB Code to implement Low Pass FIR filter for given sequence.
7	Write a MATLAB Code to implement High Pass FIR filters for given sequence.
8	MATLAB Code to implement Band Pass FIR filters for given sequence.
9	To Design a Hilbert transform function using Bartlett and Hamming Windows.
10	Design a Butterworth low pass filter for given Specifications. 11 12. 13. 14
11	To design a Cheby shev I low pass filter for given Specifications.
12	Design a Cheby shev II low pass filter for given Specifications.
13	Introduction of Code Composer Studio.
14	Generate Sign Wave in CCS.
15	To Design and verify FIR/IIR filter in CCS.

a. Course Name: Industrial Networking

b. Course Code: 303122435/ 303122436

c. Prerequisite: Basic knowledge of Computer languages.

d. Rationale: Introduction to analysis and design of computer and communication networks through understanding the network layered architecture and the protocol stack and by conducting hands-on programming and lab activities

e. Course Learning Objective:

CLOBJ 1	Define industrial networking and understand its importance in industrial automation and control systems.
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CLOBJ 2	Explore common communication protocols used in industrial networks, such as Modbus, Profibus, Profinet, EtherNet/IP, and others.
CLOBJ 3	Study the use of Ethernet in industrial applications and its variations, including time-sensitive networking (TSN) for real-time communication.
CLOBJ 4	Understand the use of wireless technologies in industrial networking, including Wi-Fi, Bluetooth, and wireless sensor networks.
CLOBJ 5	Learn about different network topologies and architectures suitable for industrial applications.
CLOBJ 6	Learn about security measures, including authentication, encryption, and intrusion detection, to protect industrial communication systems.

f. Course Learning Outcomes:

CLO 1	After Learning the course the students shall be able to: Explain the concept of TCP/IP and OSI layers.
CLO 2	Analyse the Design issues and problems of all layers.
CLO 3	Analyse various algorithms. Design small projects based on security issues, the control algorithm

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	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	Computer Networks and the Internet: The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet-Switched Networks, Protocol Layers and their Service Models, Problem: Connecting to a Network , Framing, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks (802.3), Wireless, What's Next: ³ The Internet of Things	10%	4
2	Link layer :links, Access networks and LAN: Introduction to Link layers, Error detection and correction techniques, MAC protocols, Switched LAN, link virtualization, Data centre networking	15%	7
3	Network layer: Virtual Circuit and Datagram Network, Router, The Routing Algorithms, Internet Protocol (IP): Forwarding and Addressing in the Internet, Routing in the Internet, Broadcast and Multicast Routing.	15%	7
4	Transport Layer: Introduction and transport layer service, Multiplexing and Demultiplexing, Connectionless Transport: UDP, Principles of Congestion Control of Reliable Data Transfer, Connection-Oriented Transport: TCP, Principles of congestion control, TCP Congestion Control.	15%	7
5	Application Layer: Principles of network applications, Hyper Text Transfer Protocol (HTTP), Domain Name Service (DNS). FTP, Email, DNS ² The Internet's Directory Service.	15%	7
6	Wireless and Mobile networks: wireless links and networks characteristics, 802.11, cellular internet access, mobility management, mobile IP	10%	4
7	NETWORK SECURITY: Cryptography, Symmetric-Key Algorithms, Public-Key Algorithms, Digital Signatures, Management Of Public Keys, IPsec, Firewalls.	10%	4
8	Network Defence tools: Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, Firewall Protects a Network ,Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation(NAT) and Port Forwarding	10%	5
	Total	100	45

i. Text Book and Reference Book:

1. Computer Networking: A Top-Down Approach Featuring the Internet James F. Kurose, Keith W. Ross.; Addison-Wesley; 7th Edition
2. Computer Networks, By Andrew S Tannebaum; Pearson, 2012
3. Data Communication and Networking, By Behrouz Forouzan; TMH

j. Experiment List :

Sr. No.	Experiment List
1	Introduction to WIRESHARK 2. 3. 4. 5. 6. 7. 8. To Perform Unequal packet drop using UDP protocol in NS2. 9. 10. 11 12. 13. 14.
2	Generate DNS traffic and trace packets using wire shark.
3	Generate HTTP traffic, trace packets using wire shark.
4	Create a network using CISCO packet tracer
5	Packet capture and analysis of application that uses UDP .Investigate the header fields in the UDP segment as well as the checksum calculation
6	Introduction to NS2
7	To study and perform simple node connection using TCL (Tool Command language) script
8	To Perform Unequal packet drop using UDP protocol in NS2.
9	Introduction to NS3.
10	Creating point to point module using NS3.
11	Implementing CSMA protocol using NS3.
12	To study and execute Network Commands.
13	Implementation of Character stuffing and DE stuffing.
14	Implementation of Parity checker. Write a CRC code and verify it using C.

Semester 8

- 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, Photometric stereo, Depth from Defocus, Construction of 3D model from images.	15%	6
3	Image Processing and Feature Extraction Image pre-processing, Image representations (continuous and discrete), Edge detection	15%	6
4	Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion	10%	5
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%	6
6	Object Recognition Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition	10%	5
7	Image Understanding	10%	5

	Pattern recognition methods, HMM, GMM and EM.		
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 roadsigns–locating pedestrians	15%	7
	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.

a. Course Name: Project – II

b. Course Code: 303122454

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:

CLOBJ 1	Understand project life cycle phases and apply scheduling methodologies for engineering projects.
CLOBJ 2	Manage resources effectively while mitigating risks and ensuring quality standards in engineering project deliverables.
CLOBJ 3	Foster teamwork, communication, and leadership skills for diverse stakeholders within project contexts.
CLOBJ 4	Create comprehensive project documentation and reports, adhering to ethical standards and professional responsibilities.
CLOBJ 5	Apply technical knowledge, interdisciplinary approaches, and continuous improvement strategies in engineering project management.

f. Course Learning Outcomes:

CLO 1	Use and apply information from technical literature, Identify and set clearly the aims and objectives of research project.
CLO 2	Develop a research proposal and plan for a research project in an appropriate area relevant to the programme of study.
CLO 3	Source and critically review literature relevant to a chosen project topic.
CLO 4	Evaluate a range of data analysis methods, experimental methods, alternative approaches in relation to specific project objectives.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
0	-	12	6	-	-	100	-	100	200

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