Curriculum

Three Year (Six Semesters) Diploma Course In

ELECTRONICS ENGINEERING (MICROELECTRONICS)

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5rd Semester to 6th Semester

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Prepared by:

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Curriculum Development Cell

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INSTITUTE OF RESEARCH DEVELOPMENT & TRAINING U. P., KANPUR-208002

To be

Approved and Implemented by B.T.E.

U.P.

UPDATED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

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FIFTH SEMESTER

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PREFACE

An important issue generally debated amongst the planners and educators' world is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programs. The curricula for diploma programs have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma program.

The real success of the diploma program depends upon its effective implementation. However, the best curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much needed dynamism in the system.

F.R. KHAN
Director
I.R.D.T. Kanpur

ACKNOWLEDGEMENTS

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i) Sh. Narendra Kumar Bhushan, IAS Additional Chief Secretary, Technical Education Govt. of U.P. for his exemplary vision & approach.

ii) Sh. F. R. Khan Director I.R.D.T. Kanpur for continually motivating, guiding and taking keen interest in the review of curriculum.

iii) All the participants from industries, Polytechnics and other technical institutions for their professional inputs during curriculum workshops.

iv) CDC Officer and other concerning staff of IRDT for their support and assistance in conducting curriculum workshops.

v) In the last but not least would like to thanks management of the industries who spare not only their precious time but also allowed the visit of their industries to the team making the curriculum.

Ravindra Kumar
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LIST OF SUBJECT EXPERTS

The following experts participated in various workshop for Developing the Curriculum's Structure and Contents of **ELECTRONICS ENGINEERING (Microelectronics)** at I.R.D.T. Kanpur.

1. Shri Vimal Kumar, HOD G. P. Fatehpur.
2. Dr. Abhay Shukla, Professor Rama University Kanpur.
3. Dr. Sonveer Singh, HOD MMIT Hathras.
4. Shri Bhoopendra Ratan, Lecturer G.P Mainpuri.
5. Shri Kulbhaskar Singh, Lecturer G.P. Banda.
6. Shri Durgesh Pratap, Lecturer G.G. P. Cherkhari Mahoba.
7. Smt. Garima Singh, Lecturer G.P. Kanpur.
8. Shri Rajiv Kumar Jaiswal, Lecturer G.P Deeh sadar Unnao.
9. Shri Amit Shrivastav, Lecturer MMIT Kasganj.
10. Shri Avinash Mishra, Lecturer G.P. Talbehat Lalitpur.
11. Miss Priyanka Mishra, Lecturer Manyaver Kashiram G.P Tirwa Kannauj.
12. Smt. Neha Verma, Lecturer G. P. Fathepur.
13. Shri Utpal Pandey, Lecturer G. P. Barabanki
14. Shri Sachin Kumar, Lecturer G.G.P. Shamli

1. SALIENT FEATURES

1. Name of the Program	➢ Diploma in Electronics Engineering **(Microelectronics)**
2. Duration of the Program	➢ Three years (Six Semesters)
3. Entry Qualification	➢ Matriculation or equivalent NEP-2020/NSQF Level 4 as Prescribed by State Board of Technical Education, U.P.
4. Pattern of the Program	➢ Semester System
5. NSQF Level	➢ Level – 5
6. Ratio between theory and Practice	➢ 40% (Theory)/60% (Practical)

1) <u>Industrial Training/Internship:</u>

Four and six weeks of industrial training is made mandatory after the II and IV semesters during summer vacation. Total marks allotted to industrial training will be respectively 50 & 100.

In the last (6^{th} Semester) we have made the one semester Industrial training/Internship as optional along with usual classroom training.

2) <u>Audit & Pathways Subjects</u>:

As per AICTE and NEP-2020 directives, Essence of Indian Knowledge & Tradition, Indian Constitution, Entrepreneurship & Startup, subjects on Environmental Studies have been incorporated in the curriculum.

3) <u>Student Centered Activities</u>:

A provision of 3-6 Hrs per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise co– curricular activities such as expert lectures, class room seminars, games, hobby club like photography, painting, singing etc. declamation contests, field visits, NCC, NSS and other cultural activities, etc.

4) <u>Project work:</u>

Micro/Mini/Major project work has been included in the curriculum to enable the student to get familiarized with the practices and procedures being followed in the industries and also provide an opportunity to work on some live projects in the industry.

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2. EMPLOYMENT OPPORTUNITIES

1) Tele-Communication Engineering and related Departments.
2) Railways.
3) Defence Services, Para-military Forces.
4) Civil Aviation.
5) Defence Research and Development Organizations.
6) Electricity Boards and Corporations etc.
7) Research and Development Deptt.
8) Maintenance Deptt.
9) Communication Industry.
10) PCB Design and Fabrication Industry.
11) Consumer Electronics Industry.
12) Computer Assembling and Computer Peripheral Industry.
13) Semi-Conductor Devices Manufacturing Industry.
14) Maintenance of Instrumentation and Control in process Industries.
15) Internet Service Providers.
16) Public Sector Undertakings (like BHEL, BEL, HAL, IOCL, HPCL, ISRO etc).
17) D.T.H component Fabrication Industry.
18) Mobile Phone Assembly Industries.
19) Medical Electronics Equipment Industry.
20) EPBX/ Telephone Exchange Manufacturing Industries.
21) Automobile Industry.
22) Automation and Control Industry (viz bottling plant, cement plant, automobile units, escalators etc.)
23) Sales and Services of Electronic Gadgets from Small Scale Industries.
24) Call Centres.
25) CSIR

Self-Employment

1. Marketing and Sales (Distributors - whole sale and retailers).
2. Service Sector (Repair and Maintenance, job work).
3. Cable laying and jointing DBs etc.
4. Preparing Simulated Models.
5. Manufacturing unit (e.g.- LED Bulb manufacturing, Electronic chalk manufacturing, circuit manufacturing, E- Vehicle units etc.).
6. D.T.H service provider.

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3. LEARNING OUTCOMES OF THE PROGRAM

1. Program Outcomes (POs)

The Program Outcomes (POs) describe the knowledge, skills, and attitudes that students are expected to develop by the time they graduate from the Diploma in Electronics and Communication Engineering program. These outcomes reflect what graduates will be capable of doing because of the learning and training received throughout the course. They represent the professional abilities and attributes that define a diploma holder in engineering.

As per **National Board of Accreditation (NBA)**, the seven Program Outcomes for an engineering diploma graduate are as follows -

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PO1: Basics and Discipline specific Knowledge
Assimilate knowledge of basic mathematics, science, engineering fundamentals, and electronics and communication engineering.

PO2: Problem's Analysis and solution
Identify, analyse and solve problems using standard methods and established techniques.

PO3: Design and Development
Design solutions for technical problems.
Assist in designing components, systems, or processes to meet specific requirements.

PO4: Engineering Tools, Experimentation, and Testing

Use modern engineering tools and appropriate techniques to conduct experiments as per BIS standard.

PO5: Socio/ Economic /Environmental impact assessment/remedy.

Apply relevant technologies while considering societal needs, environmental impact keeping in view sustainable and ethical responsibilities.

PO6: Project Management and Communication
Apply engineering management principles, work effectively as an individual or in a team, and communicate clearly on activities.

PO7: Lifelong Learning
Recognize the importance of continuous learning and actively pursue self-improvement to keep pace with technological developments.

At the end of the diploma program, the students will be able to:

1.	To enable Communicate effectively in English.
2.	Apply basic principles of Mathematics to solve engineering problems
3.	Apply basic principles of Physics and Chemistry to solve engineering problems
4.	Prepare computerized reports, presentations using IT tools and computer application software
5.	Prepare and interpret Engineering Drawings
6.	Use cutting tools, equipment and tooling for fabrication of jobs by following safe practices at workplace
7.	Use appropriate instruments to measure various engineering parameters.
8.	Measure and computing parameters related to basic electrical engineering
9.	Use appropriate procedures for preventing environmental pollution and energy conservation
10.	Assemble, test and troubleshooting of electronic circuits consisting of passive and active components by applying appropriate soldering, testing and measurement techniques at workplaces.
11.	Understand principles of communication engineering.
12.	Understand basic principles of digital electronics and design combinationaland sequential circuits.
13.	Write basic program using C /C++
14.	Apply principles of various networks, filters and transmission lines and its associated parameters
15.	Use various power-controlled devices in industrial applications
16.	Use microprocessor and microcontroller-based system using assembly level language programming
17.	Carryout trouble shooting of different basic consumer electronic products like TV, Audio system and mobile.
18.	Use optical fiber engineering for communication systems
19.	Use different digital communication systems
20.	Program microcontroller for Embedded Systems Applications using C /C++
21.	Understand Microwave and radar engineering
22.	Understand basic concepts of control systems
23.	Understand Embedded systems and its applications
24	Work with various active and passive microwave devices.
25	Use biomedical instruments
26	Apply acquired knowledge and skill in solving a live problem or Industrial project
27	Use modern communication system
28	Understand the fundamental of Machine Learning and AI and their practical application. Familiarize with key framework and guidelines governing AI deployment

4. STUDY AND EVALUATION SCHEME- ELECTRONICS ENGINEERING (Microelectronics)

5th SEMESTER

Sr. No.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
5.1	MICROELECTRONICS FABRICATION TECHNOLOGY	PROGRAM CORE (THEORY)	04	-	-	4	40		40	60	3			60	100
5.2	PROGRAM ELECTIVE-1	PROGRAM CORE (THEORY)	03	-	-	3	40		40	60	3			60	100
5.3	ELECTRONIC SYSTEM DESIGN AND EMBEDDED SYSTEM	PROGRAM CORE (PRACTICUM)	02	-	02	3	40		40	60	3			60	100
5.4	PROGRAM ELECTIVE-2	PROGRAM CORE (PRACTICUM)	01	-	04	3	-	60	60	-	-	40	3	40	100
5.5	MICROELECTRONICS FABRICATION TECHNOLOGY	PROGRAM CORE (PRACTICAL)	-	-	06	3	-	60	60	-	-	40	3	40	100
5.6	**(Q)** OPEN ELECTIVE-3 **OR**	OPEN ELECTIVE-3* (PRACTICUM)	01	-	03	2	-	50	50	-	-	-	-	-	N/A
	*ADVANCE SKILL DEVELOPMENT	OPEN ELECTIVE-3													N/A
5.8	INDIAN CONSTITUTION	AUDIT COURSE	02	-	-	-	50	-	50	-	-	-	-	-	N/A
5.7	SUMMER INTERNSHIP (4 Weeks after 4th semester)		-	-	-	2	-	60*	60*	-	-	40*	3	40*	100*
	#Student Centered Activities	-	-	-	08			50	50	-	-	-	-		50
Total			**13**		**23**	**20**	**120**	**230**	**350**	**180**	**-**	**120**	**-**	**300**	**650**

NOTE:- (**Q**) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.

* Advance skill development mention at **5.6** in the table provide the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agency of repute of duration not less than 20 Hrs (Offline/Online).

** SUMMER INTERNSHIP (4 WEEKS) duration to be organized after fourth semester exam. Evaluation will be in fifth semester.

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests,

educational field visits, N.C.C., NSS, library, Cultural Activities and self-study etc.

6th SEMESTER (NORMAL PATHWAY)

Sr. No.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	ENTREPRENEURSHIP AND START-UP	HUMANITIES AND SOCIAL SCIENCE	02	-	-	2	40	-	40	60	3	-	-	60	100
6.2	ELECTIVE (PATHWAY)	PROGRAM CORE (THEORY)	03	-	-	3	40	-	40	60	3	-	-	60	100
6.3	ELECTIVE (SPECIALISATION)	PROGRAM CORE (PRACTICUM)	02	-	03	3	-	60	60	-	-	40		40	100
6.4	PROJECT	PROJECT	4	-	16	12	-	240	240	-	-	160	-	160	400
#Student Centred Activities			-	-	06	-	-	50	50	-	-	-	-	-	50
Total			**11**		**25**	**20**	**80**	**350**	**430**	**120**	**-**	**200**	**-**	**320**	**750**

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, library, Cultural Activities and self-study etc.

OR

(INDUSTRIAL PATHWAY)

Sr. No.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	ENTREPRENEURSHIP AND START-UP (Online Mode)	HUMANITIES AND SOCIAL SCIENCE	-	-	-	2	-	-	-	100	3	-	-	100	100
6.2	INDUSTRIAL HANDS-ON PRACTICE	INDUSTRIAL	-	-	-	12	150*			200**					350
6.3	INDUSTRIAL PROJECT	INDUSTRIAL	-	-	-	4	50*			50**					100
6.4	SEMINAR	IN-HOUSE	-	-	-	2	-	-	100	-	-	-	-	-	100
Total			-	-	-	**20**	-	-	**300**	-	-	-	-	**350**	**650**

NOTE: - 1) The industrial training tenure should not be less than 4 months

2) "ENTREPRENEURSHIP AND START-UP" course is mandatory in industrial training option. It will be taught in contact mode by his/her polytechnic institute. After completion the online course, student must appear for a separate exam conducted by Board of Technical Education, Lucknow.

3) In industrial training option student must attend a seminar at his/her polytechnic institute after training to ern 2 credit.

4) Monthly progress report attested by industrial authority must be submitted during industrial training.

5) The industrial unit must evaluate student using the format provided by polytechnic, in both credits and marks.

6) "Entrepreneurship and Start-up" course is also mandatory in Industrial internship/training mode. It will be conducted online mode by his/her polytechnic institute. After completing the online course, students must appear for exam conducted by the Board of Technical Education, Lucknow.

7)***Evaluation by faculty mentor:-**

The institute will depute one faculty member for mentoring at least 20-30 students undertaking apprenticeship training. Such mentors will monitor, guide and provide counselling to the students as and when required. Faculty mentor of the institute(s) may make a surprise visit to the internship/apprenticeship site to check the student's presence physically. (The Proforma of the evaluation is attached as the Annexure -1)

8)** **Evaluation by industry:-** The industry shall assess the candidates based on the following parameters attendance, discipline and punctuality, familiarity of tools and material, engineering skills, application of knowledge and problem-solving skills, comprehension and observation, professional ethics, safety and environmental consciousness, communication skills, supervisory skills and general conduct during the period (The Proforma of the evaluation is attached as the Annexure -2)

9)**# Evaluation through seminar presentation/Viva-Voce at the institute :-** The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

OPEN ELECTIVE-1

SR.NO.	(Q) THEORY COURSES NAME
1.	PRODUCT DESIGN AND DEVELOPMENT OR
2.	FUNDAMENTALS OF INNOVATION AND DESIGN THINKING
SR.NO.	***CERTIFICATE COURSES**
1.	COURSES CONDUCTED BY CENTRE OF EXCELLENCE (ESTABLISHED BY THIRD PARTY AS: - TATA TECHNOLOGIES. etc)
2.	COURSES CONDUCTED BY INFOSYS PRINGBOARD
3.	COURSES CONDUCTED BY TCS ION
4.	COURSES CONDUCTED BY OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL ORGANIZATION OR PLATFORMS OF REPUTE
5.	COURSES CONDUCTED BY AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
6.	COURSES CONDUCTED BY C-DAC OR NEILIT

OPEN ELECTIVE -2

SR.NO.	(Q) THEORY COURSES NAME
1.	ELECTRIC VEHICLE OR
2.	INDUSTRIAL ROBOTICS
SR.NO.	***CERTIFICATE COURSES**
1.	COURSES CONDUCTED BY CENTRE OF EXCELLENCE (ESTABLISHED BY THIRD PARTY AS: - TATA TECHNOLOGIES. etc)
2.	COURSES CONDUCTED BY INFOSYS PRINGBOARD
3.	COURSES CONDUCTED BY TCS ION
4.	COURSES CONDUCTED BY OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL ORGANIZATION OR PLATFORMS OF REPUTE
5.	COURSES CONDUCTED BY AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
6.	COURSES CONDUCTED BY C-DAC OR NEILIT

OPEN ELECTIVE -3

SR.NO.	(Q) THEORY COURSES NAME
1.	AI & ML OR
2.	IOT OR
3.	INDUSTRIAL AUTOMATION & MES
SR.NO.	***CERTIFICATE COURSES**
1.	COURSES CONDUCTED BY CENTRE OF EXCELLENCE (ESTABLISHED BY THIRD PARTY AS: - TATA TECHNOLOGIES. etc)
2.	COURSES CONDUCTED BY INFOSYS PRINGBOARD
3.	COURSES CONDUCTED BY TCS ION
4.	COURSES CONDUCTED BY OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL ORGANIZATION OR PLATFORMS OF REPUTE
5.	COURSES CONDUCTED BY AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
6.	COURSES CONDUCTED BY C-DAC OR NEILIT

PROGRAME ELECTIVE-1

SR.NO	SUBJECT NAME
1)	CONTROL SYSTEM & PLC OR
2)	MICROWAVE AND RADAR OR
3)	DIGITAL COMMUNICATION SYSTEMS

PROGRAME ELECTIVE-2

SR.NO.	SUBJECT NAME
1)	MECHATRONICS OR
2)	SIGNAL AND IMAGE PROCESSING

ELECTIVE (PATHWAY)

SR.NO.	SUBJECT NAME
1)	MANAGERIAL ECONOMICS OR
2)	FINANCE FUNDAMENTALS OR
3)	CYBER SECURITY OR
4)	DATA SCIENCE

ELECTIVE (SPECIALISATION)

SR.NO.	SUBJECT NAME
1)	MOBILE AND WIRELESS COMMUNICATION OR
2)	VLSI USING VHDL OR
3)	POWER ELECTRONIC DEVICES

5. GUIDELINES FOR ASSESMENTS OF STUDENT CENTERED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 15 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)

ii. 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)

a)	75 - 80%	6 Marks
b)	80 - 85%	8 Marks
c)	Above 85%	10 Marks

iii. * Even Semester:

25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSSactivities as per following: (by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a) State/National Level participation
b) Participation in two of above activities
c) Inter-Polytechnic level participation
d)

****Odd Semester:**

25 Marks maximum

a) Language Lab Practices
b) Group Discussion and Personality Development
c) Industrial Visits/Industrial Talks
d) Power Point Presentations and Resume Making
e) Development of Aptitude and Reasoning Skills
f) Participation in the technical Exhibitions, Symposiums, Seminars, Workshops at the Institute /District/State/National Level.

5.1	MICROELECTRONICS FABRICATION TECHNOLOGY (Theory)	L T P
		4 0 0

1. COURSE OBJECTIVES

This course introduces the fundamental science and technology behind conventional field-effect transistor (FET) microfabrication techniques. The curriculum covers key topics in semiconductor processing, including diffusion, ion implantation, thin-film growth (oxides and metals), molecular beam and liquid-phase epitaxy, lithography, plasma and wet etching, and packaging techniques. These topics form integral components of a conventional fabrication process line used in semiconductor industries. Students will gain practical knowledge and skills necessary for fabrication of real-time electronic components and will be prepared for careers in leading fabrication industries.

2. COURSE OUTCOMES(CO):

The course is structured to develop learning outcomes across cognitive, psychomotor, and affective domains. After successful completion of the course, students will be able to:

CO1: Explain fundamental processes and techniques used in VLSI fabrication technologies employed by the semiconductor industry.
CO2: Identify and describe various materials required for fabrication of FET devices.
CO3: Outline the key process steps and their significance in successful FET device fabrication.
CO4: Explain the working principles of major fabrication equipment used in the semiconductor industry for FET fabrication.
CO5: Describe characterization methods used to evaluate the performance of fabricated FET devices.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	1	2	1	-	2	*	*
CO2	3	2	1	2	1	-	2	*	*
CO3	3	3	2	2	1	-	2	*	*
CO4	3	2	2	2	1	-	2	*	*
CO5	3	3	2	3	2	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENTS

UNIT 1: IMPORTANCE OF MICROELECTRONICS IN MODERN TECHNOLOGY (10 Periods)

Review of Semiconductors Properties: Doping, Effect of doping on conductivity and biasing, Diode Equation, Capacitance of PN Junction,

Crystal Properties: Crystal Lattice, Periodic structure, Planes and Directions, Diamond and Zinc Blend Lattice,Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Flow chart of MGS to EGS Process. CZ Technique and Float Zone Technique, Silicon Wafer Shaping, Processing Considerations,

Wafer Cleaning Technology: Basic Concepts, Wet cleaning, Dry cleaning and Polishing,

Defects in Si and GaAs.

UNIT 2: EPITAXY AND OXIDATION (12 Periods)

Epitaxy: Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators,

Epitaxial Evaluation, Oxidation, Thermal Oxidation, Oxidation techniques, Oxides Properties, Dielectric (SiO_2 and Si_3N_4) deposition methods, Chemical Vapor Deposition (CVD), Plasma CVD and Sputtering, Poly Silicon deposition, Stacking faults, Oxidation systems.

UNIT 3: LITHOGRAPHY (10 Periods)

Lithography: Optical Lithography, Electron beam lithography, X-ray lithography.

Immersion, photo masks, Wet Chemical Etching, Planar Technology Process.

UNIT 4: DIFFUSION AND ION-IMPLANTATION (12 Periods)

Diffusion: Models of diffusion in solids, Fick's 1-Dimensional diffusion equation,

Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources. Ion-Implantation: lon-Implantation Technique, Range Theory, Implantation damage and annealing,

Transient enhanced diffusion and rapid thermal processing.

UNIT 5: METALLIZATION AND PACKAGING OF VLSI DEVICES (12 Periods)

Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus, Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies, CMOS fabrication steps.

5. Text Books

1. Plummer, J.D., Deal, M.D. and Griffin, P.B., "Silicon VLSI Technology: Fundamentals, Practice and Modeling", 3rd Ed., Prentice-Hall, 2000.

2. Sze, S.M., "VLSI Technology", 4th Ed., Tata McGraw-Hill, 1999.

3.Gandhi, S. K., "VLSI Fabrication Principles: Silicon and Gallium Arsenide", John Wiley and Sons, 2003.

4. Campbell, S.A., “The Science and Engineering of Microelectronic Fabrication”, 4th Ed., Oxford University Press.

6. INSTRUCTIONAL STRATEGY

This subject being of fundamental importance for diploma holders in electronics engineering and related fields, emphasis on conceptual understanding may be given by taking the help of charts.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	10	18
2	12	21
3	10	18
4	12	21.5
5	12	21.5
Total	56	100

5.2.1	CONTROL SYSTEM & PLC (Theory)	L T P
		3 0 0

1. COURSE OBJECTIVES

The course on Control Systems & PLC aims to provide students with a solid understanding of control system principles, including open-loop and closed-loop systems, feedback, and stability analysis. Students will learn to model and analyse control systems, apply control techniques like PID, and implement PLC programming for industrial automation. The course covers PLC hardware, software, and programming languages (Ladder Logic, Function Block Diagram), with a focus on real-world applications in process control. Hands-on experience in designing, implementing, and troubleshooting PLC-based systems prepares students to solve automation problems and integrate control systems into complex industrial setups.

2. COURSE OUTCOMES(CO)

The course is designed to equip students with the knowledge and skills to understand, analyze, and implement control systems and PLC-based automation. The theory will be delivered to help students achieve outcomes across cognitive, psychomotor, and affective domains.

Students will be able to

CO1• Illustrate the concept of open loop and close loop control system.

CO2• Analyse dynamic systems and evaluate their stability using standard methods.

CO3• Explain parameters of first-order and second-order control systems and perform time-domain analysis.

CO4• Interpret and compare different types of controllers used in control systems

CO5• Understand the fundamentals of PLCs, including programming concepts and instruction sets for automation.

3.SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	3	0	0	0	0	2	*	*
CO2	3	3	0	0	0	0	2	*	*
CO3	3	3	2	0	0	0	2	*	*
CO4	3	3	2	2	1	0	2	*	*
CO5	3	0	2	3	2	0	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-), No correlation (0)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. COURSE CONTENTS

UNIT 1- INTRODUCTION TO CONTROL SYSTEM (09 Periods)

Open loop Control System and Close App Control System - block diagram and its elements, properties and application (with example) and Comparison between open and close loop Control System, Block diagram of feedback Control System and its elements, Definition and Explanation of the following Control System - Linear and Non-linear System, Continuous and Discrete System, Static and dynamic System

UNIT 2- TRANSFER FUNCTION (06 Periods)

Definition of Transfer function and its use in Control System, Transfer function of the following: Open loop and Close Loop System, Simple RC low pass and High pass filter, Characteristic Equation, Pole-Zero Concept of Transfer Function, Initial value and final value theorem.

UNIT 3- TIME DOMAIN ANALYSIS AND STABILITY THEORY (10 Periods)

Time response of first order system with unit step input, Time response of second order system with unit step input, Basic idea of delay time, rise time, setting time, steady state error, max overshoot, damping ratio (No Derivation), Over damped, under damped, critically damped, un damped system (basic idea only) and Pole-zero representation, Nature of transit response, Damping ratio (No Derivation), Basic concept of stability analysis by Routh-Hurwitz Criterion

UNIT 4- BASIC CONTROLLERS (07 Periods)

Introduction to controllers, need of controller, Type of controller (Basic idea and Mathematical expression only): (a) On-off controller b) Proportional controller c) PD controller d) PI controller e) PID controller

UNIT 5- INTRODUCTION TO PLC AND INSTRUCTION SET (10 Periods)

Concept of PLC, building block of PLC, function of various blocks, limitation of relays, advantage of PLC over electromagnetic relays, different programming languages, PLC manufacturer, working of PLC, basic operation and principles of PLC, architectural details. Basic instructions like latch, master control self-holding relays, timer instruction like retentive timers, resetting of timers, counter instructions like up counter, resetting of counters.

5. TEXT BOOKS/REFERENCE BOOKS:

1 Modern Control Engineering, K. Ogata, PHI Publications.

2 Control System Engineering I.J. Nagrath and M. Gopal, New Age International Publishers.

3 Linear Control Systems, B.S. Manke, Khanna Publishers.

4 Introduction to PLCs, Gary Dunning, Tata McGraw Hill.

5 Control System (With MATLAB Programs), Sonveer Singh and Sanjay Agrwal, I. K. International

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6. INSTRUCTIONAL STRATEGY

The teacher should lay stress on the concept of control systems and its time response analysis, stability of the system and different types of controllers. The students must know what PLC is and learn its instruction set.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	**09**	**21**
2.	**06**	**14**
3.	**10**	**24**
4.	**07**	**17**
5.	**10**	**24**
Total	**42**	**100**

5.2.2	MICROWAVE AND RADAR (Theory)	L T P 3 0 0

1. COURSE OBJECTIVES

Microwave communication forms the backbone of terrestrial communication and is fundamental to mobile communication systems. Microwave links and RADAR systems are extensively used to provide reliable communication in remote regions and to perform specialized applications. This course is designed to enhance the technical skills of diploma engineers in the operation, maintenance, and troubleshooting of microwave and RADAR-based telecommunication systems.

2. COURSE OUTCOMES (CO):

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

CO1• Understand the fundamentals of microwave engineering and select appropriate microwave devices based on specific applications.

CO2• Utilize active and passive microwave components and devices effectively.

CO3• Understand the principles and operation of waveguides.

CO4• Interpret RADAR based systems for range detection and other specified application

CO5• Analyze various satellite technologies, including different types of satellites, their missions, and areas of application.

3.SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	1	1	-	-	1	*	*
CO2	3	2	2	3	-	-	1	*	*
CO3	3	2	1	1	-	-	1	*	*
CO4	3	3	2	2	1	-	1	*	*
CO5	3	2	2	2	2	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No direct correlation (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENTS

UNIT 1-FUNDAMENTALS OF MICROWAVE COMMUNICATION (04 Periods)

History, Microwave frequency spectrum, band designations and applications of microwave in various fields, Simple block diagram of microwave transmitter, receiver and microwave link repeater.

Types of propagation- Ground wave, Sky Wave and Space Wave.

Introduction to Transmission Lines, their types and applications.

UNIT 2-INTRODUCTION TO MICROWAVE DEVICES (14 Periods)

Microwave Passive Devices: Directional Coupler, Power Divider, Attenuator, Resonator

Microwave vacuum tube devices: Construction working, specifications and applications of two cavity Klystron amplifier, Reflex Klystron, Magnetron and Helix TWT. Compare the performance of Klystron, Magnetron and TWT.

Microwave semiconductor devices: Construction, working, specifications, characteristics and applications of Gunn diode. IMPATT diode. Tunnel diode, PIN diode

UNIT 3- WAVE GUIDES (08periods)

Types of Waveguides, and Propagation of waves in rectangular and circular waveguides and their applications. Advantages and disadvantages of rectangular and circular wave guides.

Modes of wave guide; Propagation constant of a rectangular wave guide, cut off wavelength, guide wavelength and their relationship with free space wavelength (no mathematical derivation). Impossibility of TEM mode in a wave guide. Comparison of wave guide with Transmission line and comparison of rectangular waveguide with circular waveguide.

UNIT 4-RADAR SYSTEMS (08 Periods)

Introduction to RADAR Fundamentals: Basic block diagram of RADAR system, RADAR performance factors: RADAR range equation, factors influencing range, effect of noise.

Types of RADAR Systems: Basic pulse RADAR system: Block diagram and description, applications.

Doppler Effect, CW Doppler RADAR: Block diagram, operation and application.

FM CW RADAR: Block diagram. Operation and application

MTI: Block diagram, operation concept of blind speed, application.

Automatic target detection RADAR, SONAR system: Working principle and applications.

UNIT 5-SATELLITE COMMUNICATION (08 Periods)

Introduction. Advantages & disadvantages of satellite system. Frequency bands, uplink & downlink frequencies. Kepler's First Law. Kepler's Second Law. Kepler 's Third Law.

Definitions of Terms for Earth-Orbiting Satellites. Orbital Elements. Apogee and Perigee Heights. Orbit Perturbations, Effects of a non-spherical earth. Atmospheric drag. Satellite angles, satellite repeaters. Station keeping. attitude control. satellite positioning. LEO, MEO, GEO satellite overview. Satellite communication system. Transponders. Crosslink, Satellite frequency allocation and frequency reuse. Block diagram of satellite earth station.

5. TEXT BOOKS/REFERNCE BOOKS

1. RADAR systems and radio aids to navigation Sen, A. K. and Bhattacharya, A. B. Mercury Learning information. PVT.LTD. New Delhi, 2017.
2. Microwave Engineering, Das, Annapurna and Das, S. K. Mc Graw Hill, New Delhi (3rd edition)
3. Microwave Engineering, Gupta, Sanjeev, Khanna publication 2015 New Delhi
4. Microwave and RADAR Engineering, Gautam, A. K., S.K. Kataria Publication New Delhi.
5. Microwave and RADAR Engineering, Kulkarni, M. Umesh Publications, New Delhi, 2009.

6. INSTRUCTIONAL STRATEGY

Microwave and radar engineering are very important subject and requires both theoretical as well as practical exposure. The teaching should be supplemented by visits to the microwave stations and using suitable audio-visual aids.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	4	10
2	14	33
3	08	19
4	08	19
5	08	19
Total	42	100

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5.2.3	DIGITAL COMMUNICATION SYSTEM (Theory)	L T P
		3 0 0

1. COURSE OBJECTIVES

Communication technologies have undergone radical advancements, primarily due to the convergence of computing and communication systems. Digital communication offers greater flexibility in data processing compared to analog communication. This course enables students to understand the facts, concepts, and working principles of digital communication systems. It introduces fundamental aspects of digital information theory, including information rate and channel capacity. The course also provides insight into digital modulation techniques, channel coding and error control methods, multiple access schemes, and spread spectrum modulation. The knowledge gained through this course equips students to apply digital communication principles effectively in modern communication systems.

2. COURSE OUTCOMES (CO):

At the end of this course, students will be able:

CO1• Explain the basic statistical concepts involved in communication theory.

CO2• Demonstrate and apply the fundamental concepts of digital communication systems.

CO3• Design basic system blocks or equipment related to digital modulation schemes.

CO4• Analyze the performance parameters of digital communication systems.

CO5• Apply the principles of information theory to digital communication systems.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO no.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO 2
CO1	3	2	-	-	-	-	1	*	*
CO2	3	2	1	1	-	-	1	*	*
CO3	3	2	3	2	-	-	1	*	*
CO4	3	3	2	2	-	-	1	*	*
CO5	3	2	1	1	-	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No direct correlation (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

1. CONTENTS

UNIT 1-INTRODUCTION TO DIGITAL COMMUNICATION (06 Periods)

Overview of digital communication systems, Analog vs. digital communication, Elements of digital communication systems, Basics of information theory, entropy, relationship between information theory and communication systems.

UNIT 2-MODULATION TECHNIQUES (10 Periods)

Pulse Amplitude Modulation (PAM), Pulse Position Modulation (PPM), Pulse Width Modulation (PWM). Pulse Code Modulation, Basic concept of sampling theorem, quantization, coding and Shannon's theorem, Types of PCM system and its application (Basic idea only)

Basic idea of: Amplitude Shift Keying (ASK) modulation and demodulation technique, Frequency Shift Keying (FSK) modulation and demodulation technique, Phase Shift Keying (PSK) modulation and demodulation technique, Quadrature Amplitude Modulation (QAM) modulation and demodulation technique

UNIT 3-ERROR CONTROL CODING (08 Periods)

Introduction to channel coding, Basics of code theory, Error detection and correction codes, Block codes and Convolution codes, Introduction to error detection and correction technique.

UNIT 4-MULTIPLEXING AND MULTIPLE ACCESS TECHNIQUES (08 Periods)

Frequency division Multiplexing (FDM), Time division Multiplexing (TDM), Code division Multiplexing (CDM), Basics of orthogonal frequency division Multiplexing (OFDM)

Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Orthogonal Frequency Division Multiple Access (OFDMA)

UNIT 5- DIGITAL TRANSMISSION FUNDAMENTALS AND PERFORMANCE ANALYSIS (10 Periods)

Line coding techniques (NRZ, RZ, Manchester), Baseband and passband transmission, Signal-to-noise ratio (SNR) and bit error rate (BER), Channel capacity, Shanon-Hartley theorem, Link budget analysis, Brief idea of interference and noise in digital communication systems.

5. TEXT BOOKS/REFERENCE BOOKS

1. Modern Digital and Analog Communication Systems, Lathi, B.P. and Ding, Z
2. Communication Systems, Haykin, S
3. Digital & Analog Communication Systems By K.S. Shanmugam, John Wiley
4. E-books/e-tools to be used as recommended by AICTE/NITTTR, Chandigarh.

Websites for Reference:

http://swayam.gov.in

6. INSTRUCTIONAL STRATEGY

The subject requires both theory and practical emphasis simultaneously, so that the student can understand the practical significance of the various areas. Visits to instrumentation and communications industries must be carried out, so as to make the students can understand where and how the various instruments are used in the industry.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	**6**	**14**
2	**10**	**24**
3	**8**	**19**
4	**8**	**19**
5	**10**	**24**
Total	**42**	**100**

5.3	ELECTRONIC SYSTEM DESIGN AND EMBEDDED SYSTEM (Practicum)	L T P
		2 0 2

1. COURSE OBJECTIVES

This course enables students to understand the fundamentals of electronic system design and apply these principles to develop complete electronic systems. Students will identify and select appropriate sensors and actuators for interfacing with real-world environments. The course introduces modern embedded systems, including operating system concepts and real-time system design, enabling students to analyze embedded system requirements and design real-time solutions. Starting with the 8051 microcontroller and its instruction set, the course further covers the Arduino platform, emphasizing programming the Arduino Uno to develop real-time embedded applications.

2. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that

Students will be able to

CO1• Understand the fundamentals of electronic system design and the role of sensors and actuators.

CO2• Explain the key concepts of 8051 and Arduino microcontrollers and their architectures.

CO3• Analyze circuit and system requirements for embedded applications.

CO4• Apply learned concepts to interface devices and develop real-time applications.

CO5• Develop a comprehensive theoretical and practical understanding of 8051/Arduino-based embedded systems

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO no.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO 2
CO1	3	1	-	-	-	-	1	*	*
CO2	3	1	1	2	-	-	1	*	*
CO3	3	3	2	2	-	-	1	*	*
CO4	3	2	3	3	1	-	2	*	*
CO5	3	2	3	2	1	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENT

UNIT 1- BASICS OF ELECTRONIC SYSTEMS DESIGN (05 Periods)

Definition, Purpose and Scope; System Architecture for Electronic Product Designs; Breakdown of an Electronic System Design; Requirements; Electromagnetic Interference in Electronic Systems and Its Impact; Concept of Grounding and Its Significance, PCB designing principals, Etching process, Types of etching.

Ex. No.	Name of Experiment	Periods
1	Familiarization with different types of PCB'S Materials and their key specifications.(Bakellite,FR4 etc)	2
2	Schematic creation and PCB Layout for simple circuits using open source software	2
3.	Creating a PCB that is fully prepared for component installation with PCB grounding techniques.	2

UNIT 2 SENSORS AND ACTUATORS (06 Periods)

Sensor: Definition: Sensor Characteristics - Sensitivity, Linearity, Range, Resolution, Accuracy, Repeatability, and Hysteresis. Types of Sensors: Temperature Sensor, Ultrasonic Sensor, Gas Sensor, Level Sensor, Ph Sensor, Flow Sensor, Humidity Sensor, Proximity Sensor, Pressure Sensor, etc.

Actuator: Definition: Actuator Principles and Classification, Energy Source-Based Actuators (i.e., Pneumatic Actuator, Hydraulic Actuator, Electric Actuator, Thermal Actuator, Magnetic Actuator, and Piezoelectric Actuator). Classification of Actuators by Motion: Linear, Rotary, and Semi-Rotary.

Ex. No.	Name of Experiment	Periods
4.	Identifying various types of sensors and analyzing their specifications through datasheets	2
5.	Identifying various types of actuators and analyzing their specifications through datasheets	2

UNIT 3 - EMBEDDED SYSTEM (06 Periods)

Embedded system architecture Types of Architecture of Embedded Processors: Von Neumann, Harvard, Super Harvard, RISC, CISC, DSP, Multi core processor, factors affecting embedded systems, Types of embedded O.S: Non real time O.S, Real time O.S, Mobile O.S

Ex. No.	Name of Experiment	Periods
6.	Familiarization with different types of microcontrollers and their specifications and IC packages (ESP8266/32, Arduino Classic, MKR,	2

	Nano and Mega family, Raspberry pi)	

UNIT 4- 8051 MICROCONTROLLER (6 Periods)

Introduction to 8051 Pin Diagram and Description, Memory Organization, Special Function Registers, Addressing Modes, Interrupts, Timers, Serial Communication. Difference between the C language and Embedded C language,

Ex. No.	Name of Experiment	Periods
7.	Template for embedded C program for 8051 (using reg.51)	2
8.	Write a program to load a number into Accumulator	2
9.	Write a program to load three numbers into Accumulator and send them to port 1	2
10.	Write a program to explain different logical operations.	2

UNIT 5 COMMUNICATION WITH ARDUINO UNO (05 Periods)

Arduino Uno specifications including power ratings, digital and analog peripherals. Arduino Uno Ports, Pins, Digital and Analog Peripherals, Familiarizing with the Arduino IDE, Arduino I/O functions, Arduino Interrupts, Serial Peripheral Interface and Communication and their programming.

Ex. No.	Name of Experiment	Periods
11.	Write a program for LED blinking with 1s delay	2
12.	Write a program for handling two LEDs blinking alternatively with a delay of 2s	2
13.	Write a program to read digital states of a push button and print in IDE serial monitor	2
14.	Write a program to send a message using serial communication	2

5. TEXT BOOKS/REFERNCE BOOKS

1. John F. Wakerly,Digital Design: Principles and Practices, 5th edition, Pearson Publications, 2018
2. Charles Kitchin and Lew Counts, A Designer's Guide to Instrumentation Amplifiers,3rd edition, Analog Devices, 2006

3. Eamon Nash, Errors and Error Budget Analysis in Instrumentation Amplifier Applications, 3rd edition, Analog Devices, 2006
4. Lyla B. Das, Embedded systems: An Integrated Approach, 1st edition, Pearson Education, 2013
5. Steve Furbe, ARM System on chip Architecture, 2nd Edition,Pearson Education, 2015

6. INSTRUCTIONAL STRATEGY

The subject requires both theory and practical emphasis simultaneously, so that the student can understand the practical significance of the various areas. Visits to instrumentation and communications industries must be carried out, so as to make the students can understand where and how the various instruments are used in the industry.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	5	17
2	6	22
3	6	22
4	6	22
5	5	17
Total	28	100

5.4.1	MECHATRONICS (Practicum)	L T P 1 0 4

1. COURSE OBJECTIVES

Mechatronics is a rapidly evolving interdisciplinary field that integrates mechanical, electrical, electronics, computer, and control engineering. This fusion enables the design and development of advanced, reliable, and cost-effective electro-mechanical systems. With increasing industrial automation and smart manufacturing, mechatronic systems are being widely adopted across various sectors. Consequently, there is a growing demand for diploma engineers who are skilled in installing, operating, and maintaining these integrated systems in real-world industrial applications.

2. COURSE OUTCOMES (CO):

Students will be able to

CO1• Illustrate various types of mechatronics systems and explain their architecture.

CO2• Select and apply appropriate sensors and transducers used in mechatronics systems.

CO3• Explain and demonstrate the functioning of various components used in different mechatronic systems.

CO4• Install, operates, and maintains CNC machines.

CO5• Interface PLC with SCADA systems for specific industrial applications.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	1	1	-	-	1	*	*
CO2	3	2	2	2	-	-	1	*	*
CO3	3	2	2	2	-	-	1	*	*
CO4	3	2	3	3	1	1	2	*	*
CO5	3	2	3	3	1	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENT

UNIT 1 INTRODUCTION (03 Periods)

Introduction to Mechatronics: Mechatronics; Importance of Mechatronics; Systems: Measurement systems; Control systems and their types; Closed-loop control System; Automatic water level controller; Sequential controllers-washing machine

Mechatronics system architecture: Sensors, signal conditioners, PLC/Embedded controllers, pneumatic, hydraulic and electrical actuators.

Introduction to Real Time Mechatronics System

Ex. No.	Name of Experiment	Periods
1.	Familiarize students with measurement systems and control systems, including the working principle of closed-loop control systems.	3
2	Design and implement an automatic water level controller system, which uses sensors to control the water flow into a tank.	3
3.	Implement a sequential control system, such as a washing machine controller, using a microcontroller or PLC	3
4.	Study the integration of sensors, signal conditioners, actuators, and controllers in a mechatronics system, with a focus on industrial applications.	3

UNIT 2 SENSORS & SWITCHES (03 Periods)

Sensors: Principle of operation and application of each. Proximity, Motion Sensors, Pressure sensor, High and low temperature measurement sensors, Light Sensors, Selection of Sensors.

Switches: Principle, working and applications of-Limit switches, proximity switches like inductive, capacitive and optical (deflecting and through beam type),

Ex. No.	Name of Experiment	Periods
5.	Understand the principle of operation and applications of proximity sensors	3
6.	Study how motion sensors detect and respond to movement.	3
7.	Study the operation and applications of pressure sensors.	3
8.	Study the principle and applications of LDR, photodiodes, and phototransistors.	3

UNIT 3 -ELECTRICAL & MECHANICAL SYSTEM (03 Periods)

Electric actuators, Stepper motor, servo motors, DC motor, DC brushless motors, AC motor (Only diagram). Relays Principle of operation and application, latching, triggering, Types of relays- solid state.

Hydraulic systems: Physical components of hydraulic systems

Pneumatic systems: Air compressors, filters and regulators.

Ex. No.	Name of Experiment	Periods
9.	To understand the working principle and applications of electric actuators	3
10.	To understand the working principle and applications of stepper motors, Servo motor, DC motors, DC brushless motors.	3
11.	To understand the **principle of operation** and **applications** of **relays** (including latching, triggering, and solid-state relays).	3

UNIT 4- SIGNAL CONDITIONERS (03 Periods)

Need of isolators, filters, amplifiers, fluid amplifiers, and optical amplifiers mechatronics systems.

Computer Aided Control Systems: CNC Machines: various blocks of CNC machine, advantages of CNC, Part programming of CNC machines, G codes and M codes, small application programs, CNC based machine example.

Ex. No.	Name of Experiment	Periods
12.	To understand the function and need for various isolators, filters, amplifiers, and their applications in mechatronics systems.	3
13.	To understand the components, working, and programming of CNC machines and the role of computer-aided control systems in mechatronics.	3
14	To simulate and troubleshoot common CNC machine operations and errors.	3

UNIT 5- INTRODUCTION TO SCADA AND PLC (02 Periods)

SCADA: Data acquisition system, communication technologies, monitoring and supervisory functions. PLC: Block diagram, programming languages, Applications, Interfacing of PLC to SCADA.

Case studies of mechatronics systems: A Microcontroller based pick-and-place robot, Microcontroller based antilock brake system.

Ex. No.	Name of Experiment	Periods
15.	To understand the **SCADA system**, its components, and its role in data acquisition, communication, and supervisory control.	3
16.	To understand the principles of **PLC programming**, its block diagram, and its application in real-time systems.	3
17.	To explore various **microcontroller-based mechatronics systems** by designing, simulating, and implementing real-world applications.	3
	REVISION	5

5.INSTRUCTIONAL STRATEGY

The instructional strategy for Mechatronics includes a blend of classroom teaching, hands-on laboratory sessions, industry-relevant projects, and the use of multimedia tools. Emphasis is placed on collaborative learning, simulation software, real-world applications, and continuous assessment to develop practical skills, interdisciplinary knowledge, and problem-solving abilities essential for modern industries.

5.4.2	SIGNAL AND IMAGE PROCESSING (Practicum)	L T P
		1 0 4

1. COURSE OBJECTIVES

The Signal and Image Processing course provides students with both foundational and advanced concepts in processing digital signals and images. It covers essential techniques such as filtering, sampling, Fourier transforms, and convolution, enabling students to analyze, transform, and manipulate digital signals effectively. In the image processing module, the course explores methods for enhancement, restoration, compression, segmentation, and feature extraction. Students gain a balanced understanding of theoretical principles and practical implementations using tools such as MATLAB or Python.

2. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to.

CO1• Understand different types of signals, including continuous and discrete, odd and even, periodic and aperiodic signals.
CO2• Explain and apply transform techniques for analyzing continuous-time signals and systems.
CO3• Analyze the fundamental concepts underlying digital image processing systems.
CO4• Evaluate methods used for image enhancement and restoration to improve image quality.
CO5• Categorize different image compression strategies and assess techniques for image segmentation and representation.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO no.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO 2
CO1	3	1	-	-	-	-	1	*	*
CO2	3	2	2	2	-	-	1	*	*
CO3	3	2	2	2	-	-	1	*	*
CO4	3	3	2	2	-	-	1	*	*
CO5	3	2	2	2	1	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENT

UNIT 1- BASICS OF SIGNALS AND SYSTEMS (02 Periods)

Step, Ramp, Pulse, Impulse, Real, complex and exponentials _ Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals

Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non causal, Stable & Unstable

Ex. No.	Name of Experiment	Periods
1	Understand various signal types in the time domain.	2
2	Learn about signal operations such as addition, multiplication, and time-shifting.	2

UNIT 2 -FOURIER TRANSFORM AND LAPLACE TRANSFORM (04 Periods)

Fourier Transform: Fourier series for periodic signals – Fourier Transform – properties Laplace Transform: Laplace Transforms and properties - convolution and properties

Ex. No.	Name of Experiment	Periods
3.	Transform signals from the time domain into the frequency domain.	2
4.	Explore critical properties of the Fourier Transform such as linearity, time-shifting, frequency-shifting, scaling, and duality.	4
5.	Introduce the Laplace transform as a tool for analyzing continuous-time signals and systems, and verify its properties such as linearity, time-shifting.	4

UNIT 3- BASICS OF IMAGE PROCESSING (04Periods)

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition, Introduction to image sampling and quantization, Color Image Fundamentals: RGB models

Ex. No.	Name of Experiment	Periods
6.	Introduction to Digital Image Processing Environment	2
7.	Understand image as a matrix and perform fundamental operations	4
8.	Break down an image into its RGB components	4

9.	Simulate the process of image capture using virtual sensors.	4

UNIT 4-IMAGE ENHANCEMENT AND RESTORATION (02 Periods)

Image Enhancement: Spatial Domain: Gray level Transformations-Image negative-contrast stretching - Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial filtering.

Image Restoration – introduction to degradation model & Noise models

Ex. No.	**Name of Experiment**	**Periods**
10.	Understand human perception of brightness and contrast.	4
11.	Improve the visual quality of images by suppressing degradation.	4
12.	Understand how reducing intensity levels affects image quality.	4
13.	Understand and apply basic pixel intensity transformations.	2

UNIT 5- IMAGE SEGMENTATION AND COMPRESSION (02 Periods)

Image Segmentation: Edge detection, Region based segmentation – Region growing – Region splitting and merging

Image Compression: Need for data compression, Huffman, JPEG standard, MPEG

Ex. No.	**Name of Experiment**	**Periods**
14.	Perform segmentation by dividing and combining image regions based on uniformity	2
15.	Demonstrate how compression reduces image size and storage needs.	4
16.	Simulate the core steps of JPEG compression.	4
17.	Understand basic principles behind video compression.	4

5. TEXT BOOKS/REFERENCE BOOKS:

1. A.V. Oppenheim, A.S. willsky and S.H. Nawab, Signals and Systems, 2nd Edition, Prentice-Hall of India, 2015

2. Rafel C.Gonzalez and Richard E. woods, Digital Image processing, 4th edition, Pearson Inc, 2018

3. Simon Haykin and Barry Van Veen,Signals and Systems, 2nd edition, Wiley, 2007

6. INSTRUCTIONAL STRATEGY

Engage and motivate students through interactive teaching that builds confidence and connects course concepts to real-world applications. Use demonstrations, simulations, and hands-on activities in a theory-demonstrate-practice-activity approach. Encourage critical analysis by having students assess experiment outcomes and identify errors, ensuring outcome-driven learning and improved employability.

5.5	MICROELECTRONICS FABRICATION TECHNOLOGY (Practical)	L T P
		0 0 6

1. COURSE OBJECTIVES

This course introduces the fundamental science and technology behind conventional field-effect transistor (FET) microfabrication techniques. The curriculum covers essential semiconductor processing topics such as diffusion, ion implantation, thin-film growth (oxides and metals), molecular beam and liquid-phase epitaxy, lithography, plasma and wet etching, and packaging techniques. These processes form integral components of a typical fabrication process line used in semiconductor industries. Students will gain practical knowledge and skills required for fabrication of real-time electronic components and will be prepared for careers in leading fabrication industries.

2. COURSE OUTCOMES (CO):

The course is designed to develop learning outcomes across cognitive, psychomotor, and affective domains. After successful completion of the course, students will be able to

CO1: Explain the basic processes and techniques used in VLSI fabrication technologies employed by the semiconductor industry.
CO2: Identify and describe the materials required for fabrication of FET devices.
CO3: Outline the various process steps involved in FET device fabrication and explain their significance.
CO4: Describe the major equipment and machinery used in semiconductor fabrication for FET devices.
CO5: Explain characterization techniques used to evaluate the performance of fabricated FET devices.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	1	2	1	-	2	*	*
CO2	3	2	1	2	1	-	2	*	*
CO3	3	3	2	2	1	-	2	*	*
CO4	3	2	2	3	1	-	2	*	*
CO5	3	3	2	2	2	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. LIST OF EXPERIMNTS

Ex. No.	EXPERIMNTS
1.	Introduction to the scope and importance of modern fabrication of microelectronic devices.
2.	Understanding cleanroom protocols and safety guidelines.
3.	Demonstration of thermal oxidation by growing a thin layer of SiO2 on a silicon wafer.
4.	Introducing photolithography by transferring a pattern from mask to wafer.
5.	Demonstration of wet etching and dry etching.
6.	Understanding of thermal diffusion by various dopants into silicon.
7.	Verification of precise doping via ion beam followed by annealing to activate dopants.
8.	Demonstration of physical vapour deposition (PVD) and chemical vapour deposition (CVD).

5. INSTRUCTIONAL STRATEGY

This subject being of fundamental importance for diploma holders in electronics engineering and related fields, emphasis on conceptual understanding may be given by taking the help of charts.

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5.6.1	AI & ML (Practicum)	L T P
		1 0 3

1. COURSE OBJECTIVE

This course is designed to equip students with essential theoretical and practical skills need for understanding the requirements, collection of data, pre-processing of data, building and deploying machine learning and artificial intelligence solutions to real world applications. Participants will gain hands-on experience with the latest software, enabling them to adopt latest technologies in line with industry requirements and building competency in the Machine Learning and Artificial Intelligence field.

2. COURSE OUTCOME

- Understand the fundamentals of Machine Learning and AI and their practical applications.
- Understanding of Basic Mathematical Concepts used in AI and ML.
- Understand Data Collection and Data Pre-Processing.
- Understand Basics of AI and Machine Learning
- Develop python programming skills for Machine Learning and AI.
- Understand the role of Supervised, Unsupervised and Deep Learning in real world applications.
- Select appropriate Machine Learning Algorithm for specific applications.
- Implementation of Regression Analysis for Prediction.
- Train a logistic regression model for binary classification.
- Train and Evaluate SVM for classification.
- Implementation of Decision Tree Machine Learning Model.
- Implement K – Means clustering.
- Build Supervised Machine Learning Model.
- Build Unsupervised Machine Learning.
- Build Reinforcement Machine Learning Model.
- Train a convolutional network (CNN) for image classification task.
- Evaluate Machine Learning Model.
- Deployment of Machine Learning Model.

- Understand Ethical challenges in AI and ML
- Understand importance of Data Protection.
- Understand social impact of AI.
- Evaluate the responsibility and accountability of AI systems.
- Familiarize with key ethical frameworks and guidelines governing AI deployment.

COURSE CONTENTS

1 **Industrial Safety Practices**

- Fire Extinguishers & its Types
- Safely handling Tools & Equipment
- Use of proper Tools & Equipment & its maintenance
- OSH & practices to be observed as a precaution

2 **Fundamentals required for AI and ML**

- Introduction to Artificial Intelligence and Machine Learning
- Need of AI and ML
- Basic Mathematical concepts related to AI and ML
- Data Collection, Data Processing and Cleaning
- Types of Data Sources
    - Structured Data
    - Unstructured Data
    - Semi Structured
    - Realtime Data
    - Open Data Set
    - Data Scraping
- Data Acquisition Techniques
    - APIs (Application Programming Interfaces): Collection of from External Sources)
    - Web Scrapping
    - Surveys and Forms
    - Sensor Data
    - Database and Data Warehouse
- Data Integration
    - Combining Data from Multiple Sources
    - Data Merging (Combing Data from different Tables)
    - Data Aggregation
- Data Pre-Processing
    - Data Cleaning
    - Outlier Detection and Removal
    - Duplicate Data

3 **Programming concepts for AI and ML**

- Python Basics
- Python Structure
- NumPy
- Pandas
- Matplotlib and Seaborn
- Scikit-learn

4 **Introduction to Supervised Machine Learning**

Types of Machine Learning Techniques (Supervised, Unsupervised and Reinforcement Learning)

- Supervised Learning
  - Regression
  - Classification
  - Logistic Regression
  - Support Vector Machines
  - Decision Tree
  - Random Forest
  - K – Nearest Neighbors (KNN)
  - Use cases of Regression and Classification

Introduction to Unsupervised Learning

- Clustering
  - K – Means Clustering
  - Hierarchical Clustering
  - DBSCAN
- Dimensionality Reduction
- Anomaly Detection
- Use cases of clustering and Dimensional Reduction
- Building Machine Learning Model
- Model Evaluation and Validation
- Machine Learning Model Deployment

5 **Deep Learning, Reinforcement Learning and Natural Language Processing**

- Fundamentals of Deep Learning
- Convolutional Neural Networks (CNNs)
- Recurrent Neural Networks (RNNs)
- Natural Language Processing
- Reinforcement Learning
- TensorFlow and Kera

Generative AI

- Understanding of Gen AI
- Applications of Gen AI

- Development of Gen AI model
- Integration of Gen AI in Mobile App.
- Deployment

6 **Deep Learning Applications**

- Computer Vision
- Natural Language Processing
- Speech Recognition
- Model Deployment

7 **Ethics and Responsibility in AI and Machine Learning**

- Ethics in AI and ML
- Accountability and Responsibility
- Privacy and Data Protection
- Social Impact of AI
- Ethical Guidelines

Ex. No.	Name of Experiment	Hours
1.	Load a Dataset and perform basic preprocessing	
2.	Splitting of Dataset into Training and Testing Set	
3.	Explore Python Libraries Pandas, NumPy, Matplotlib etc.	
4.	Build Machine Learning Model for Linear Regression Analysis for predict.	
5.	Implement K – Means clustering to segment customer based on purchasing behaviour.	
6.	Build a Machine Learning Model – Decision Tree	
7.	Build a Machine Learning Model – Random Forest	
8.	Build a Machine Learning Model for Anomaly Detection	
9.	Build SVM model and evaluate performance (Precision, Recall, F-Score and Confusion Matrix)	
10.	Build a Neural Network using Keras or TensorFlow to classify the handwriting digits.	
11.	Implement a Convolutional Neural Network to classify images using given dataset.	
12.	Build a Recurrent Neural Network (RNN) for Sentiment Analysis.	
13.	Implement a Chatbot using RNN.	
14.	Compare two different Gen AI models	
15.	Integrate a Trained Machine Learning Model in Mobile APP for Prediction.	
16.	Case Studies	
17.	Mini Project	

4.INSTRUCTIONAL STRATEGY

The teacher should lay stress on the fundamentals of artificial intelligence and Machine Learning. The students must know about scope and future aspects of artificial intelligence and Machine Learning.

5.6.2	IOT (Practicum)	L T P
		1 0 3

1. COURSE OBJECTIVE

This course is designed to develop skills on Internet of things (IOT) using latest software & Hardware. The course helps students to build IOT applications and devices using controller, sensors, actuators, and other electronic components. It also helps candidates to develop competency on latest technologies using IOT in various sectors such as home automation, smart city, agriculture, automotive, manufacturing etc. This course also provides opportunities for starting their own start up by developing novel IoT applications.

2. COURSE OUTCOMES

- Comply with Industry health and safety guidelines.
- Identify the market needs & customer demand analysis.
- Ability to develop basic circuit design and measurement techniques and calibration according to common engineering standards symbols, unit, schematics.
- Ability to generate ideas for upgrading existing product or creation of new product as per customer requirement.
- Ability to convert Ideas into reality by developing prototype model with the help of microcontrollers and wired or wireless protocols.
- Ability to develop IOT applications based on specific needs.
- Ability to handle cloud operations for internet of things applications.
- Ability to implement ideas for entrepreneurship and better career opportunities.
- Create value by using problems solving approach and by applying innovation techniques.
- Ability to develop IoT applications related to home automation, agriculture, smart city, automotive, manufacturing etc.
- Able to create innovative products, processes, services, business models etc.
- Able Create and protect their intellectual property.
- Start Their Own Business | Start up | Entrepreneurship.

3. COURSE CONTENTS

1 **Introduction to Industrial Safety Practices**

- Fire Extinguishers & its Types
- Safely handling Tools & Equipment
- Use of proper Tools & Equipment & its maintenance
- OSH & practices to be observed as a precaution

2 **Fundamentals of Internet of Things**

- Introduction of Internet of Things
- Basics of electricals & electronics components used in IoT
- History of IoT
- Applications, Benefits and Limitations of IoT
- Important components of IoT – Micro Controller, Sensors, actuators, communication protocol, cloud etc
- IoT Architecture – Physical layer, Network layer, Data processing layer, Application layer.

3 **IoT Microcontrollers and Single board computer**

- Introduction to microcontroller
- Different types of microcontrollers, Arduino, Raspberry pi
- Introduction to input, output and PWM, interface of camera to raspberry pi, interface of various sensors to raspberry pi, IOT protocol (HTTP, MQTT, HTTPS) for RPI, Study connection of raspberry pi to cloud
- Important features of microcontroller
- Specification of microcontroller
- Selection of microcontroller based on IoT application.
- Basic programming of microcontroller
- Advanced programming of micro controller
- Debugging of program, Testing of program

4 **IoT Sensors**

- Introduction of Sensors
- Various types of Sensors and their applications
- Specifications of sensors
- Working principle of important sensors
- Comparison of sensors and relative advantages and limitations
- Selection of sensor based on IOT application.
- Interfacing of sensors with microcontroller to develop IOT application.
- Testing of sensors for IOT application

5 **Use of Actuators for IoT applications**

- Introduction to actuators
- Various types of actuators
- Working principle of actuator
- Applications of actuators
- Comparison of various actuators and relative advantages and limitations
- Selection of actuator based on IOT application

6 **IoT Network Connectivity**

- Introduction to IoT network technologies
- Various options for IoT connectivity
- Comparison of various options for IoT connectivity
- Selection of IoT connectivity based on application parameter like Range, Data size, Rate of data transfer, Type of data, Number of devices to be connected etc.

7 **Cloud and Application of IoT**

- Various options available to store IOT Data
- Comparison of storage options
- Storage on premises and Cloud
- IOT Database
- Selection of database
- Interfacing Database with IOT application
- Requirements for IoT applications
- Selection of sensors and actuators as per IoT application
- IoT dashboard building
- Authentication
- IoT application building as per real world application related to Smart City, Healthcare, Automotive, Manufacturing.
- IoT based mobile application development
- Use of API in IoT application Building
- Basics of Machine Learning and AI
- Use of Machine Learning and Artificial Intelligence in IoT
- Industrial Use cases

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Ex. No.	Name of Experiment	Hours
1.	Comply with Industry health and safety guidelines.	
2.	Identify the market needs & customer demand analysis.	
3.	Ability to develop basic circuit design and measurement techniques and calibration according to common engineering standards symbols, unit, schematics.	
4.	Ability to generate ideas for upgrading existing product or creation of new product as per customer requirement.	
5.	Ability to convert Ideas into reality by developing prototype model with the help of microcontrollers and wired or wireless protocols.	
6.	Ability to develop IOT applications based on specific needs.	
7.	Ability to handle cloud operations for internet of things applications.	
8.	Ability to implement ideas for entrepreneurship and better career opportunities.	
9.	Create value by using problems solving approach and by applying innovation techniques.	
10.	Ability to develop IoT applications related to home automation, agriculture, smart city, automotive, manufacturing etc.	
11.	Able to create innovative products, processes, services, business models etc.	
12.	Able Create and protect their intellectual property.	
13.	Start Their Own Business | Start up | Entrepreneurship	

4.INSTRUCTIONAL STRATEGY

The IoT can be a useful educational tool for students who use technology to solve unsolvable problems to increase their training skills. Students' academic behavior can also be tracked and recorded via wearable technology, which improves their interactive learning environment. IoT for education can help *increase student engagement, create student-centered curriculums, and foster* immersive language learning. Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities: Seminars, Library/Internet survey, MOOCs, Open source simulation software modules etc on relevant topics.

5.6.3	INDUSTRIAL AUTOMATION & MES	L T P
		1 0 3

1. COURSE OBJECTIVE

This course is designed to provide a comprehensive understanding and hands on experience on Industrial Automation and Manufacturing Execution Systems (MES) to excel in the automation sector across various manufacturing domains. This includes Programmable Logic Controllers (PLC), Supervisory Control and Data Acquisition (SCADA), Human Machine Interfaces (HMI), Variable Frequency Drives (VFD), Manufacturing Execution System (MES), and the integration of these components to create cohesive and efficient systems. Participants will gain hands-on experience with the latest software and hardware tools, enabling them to adopt modern automation techniques in line with industry standards and build competency in the automation sector.

2. COURSE OUTCOME

- Adhere to industry health and safety standards when working with automation tools.
- Grasp the fundamentals of automation processes and their practical applications.
- Develop skills to program and operate Programmable Logic Controllers (PLCs).
- Select appropriate input and output devices for specific applications.
- Work with various industrial communication protocols.
- Understand the role and features of Human-Machine Interfaces (HMIs) in automation.
- Create dynamic HMI screens and manage alarms and events in HMI systems.
- Design recipes, manage security, and provide authorization in HMI systems.
- Learn about Variable Frequency Drives (VFDs) and their industrial uses.
- Connect VFDs to motors and analyse the effects of VFD parameters on motor.
- Understand and implement the features of SCADA systems in industrial settings.
- Design dynamic SCADA screens, manage alarms, handle recipes, implement security,
  - apply script programming and configure SCADA with PLCs.
- Integrate PLC, VFD, HMI and SCADA systems using communication protocols.
- Understand the role of MES and learn how MES improves production efficiency and
  - quality control.
- Implement MES to track and document the transformation of raw materials to
  - finished goods.
- Understand the integration of MES with other industrial systems like PLCs.
- Learn about the benefits of MES in reducing production downtime and enhancing

- traceability.
- Develop skills to configure and customize MES solutions for specific industrial needs.

3. CONTENTS

Sr No	Course contents
1	**Industrial Safety Practices** • Fire Extinguishers & its Types • Safely handling Tools & Equipment • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution
2	**Fundamentals of Industrial Automation** • Introduction to industrial automation • Need and application of automation • Benefits of automation • Types of Industrial automation • Important Components of Automation • Discrete, Continuous and Batch Manufacturing • Open-loop vs. Closed-loop systems • Introduction to PLC, HMI, VFD, SCADA, MES • Industrial sensors: types and applications • Actuators: motors, valves, pneumatics • Signal conditioning and A/D conversion • Process variables: temperature, pressure, flow, level • PID control and its applications • Control panel components and wiring standards • Industrial communication protocols
3	**Programmable Logic Controller (PLC)** • Introduction to Programmable Logic Controller (PLC) • Types of PLCs and selection criteria. • Application and advantages of PLC. • Important components of PLC • Numbering systems: binary, hexadecimal, BCD • PLC memory organization and addressing. • Explain sink and source concept. • Interfacing of PLC with field devices. • PLC communication protocols: Modbus, Profibus, ethernet/IP • Types of PLC programming • Ladder logic programming basics. • Conditional logic: AND, OR, NOT, NAND, NOR XOR, XNOR Gates • Timers and counters in PLC. • Explain advance instruction used in PLC.

	• Fault handling and troubleshooting in PLCs • Industrial case study of PLC.
4	**Variable Frequency Drive (VFD)** • Introduction to Variable Frequency Drive (VFD) • Basics of AC motors • Application of VFD • Components of a VFD: rectifier, DC bus, inverter • Types of VFDs: scalar control vs. vector control • Connections and control mechanism • VFD parameter configuration and settings • Study motor protection and overload prevention • Understand energy efficiency optimization using VFD • Troubleshooting and fault diagnosis in VFDs • Regenerative braking and energy recovery in VFD • Learn Modbus and ethernet communication for VFDs • Industry applications of VFD in HVAC, pumps, and conveyors • Case study: VFD implementation for smart energy saving • Interfacing of VFD with PLC & SCADA.
5	**Human Machine Interface** • Introduction to HMI • Role of HMI in industrial automation • Components of HMI • Compare HMI and SCADA • Communication protocols in HMI • User interface of HMI software. • Building basic HMI control animations. • Alarms and event logging • Security and user access management • Multi-screen navigation in HMI systems • Study trending and historical data logging • Communication between HMI and PLC • SCADA-HMI integration • Troubleshooting common issues in HMI. • Industrial case study: HMI in production line
6	**Supervisory Control and Data Acquisition (SCADA)** • Introduction to Supervisory Control and Data Acquisition (SCADA). • Application and advantages of SCADA • Important components of SCADA • Block diagram of SCADA • SCADA communication protocols. • Types of tags and its usage. • Explore the features of SCADA. • User interface of SCADA software • Building basic SCADA screens with animation.

	• Dynamic properties like sizing, location, blinking, visibility, percentage filling, object size, orientation, etc. • Alarm management and event logging in SCADA • Historical data logging and trending in SCADA. • Recipe management. • Script programming. • Security options and administrative levels in SCADA. • Explore data transfer feature in SCADA software. • SCADA and PLC interfacing for real-time control • Troubleshooting and fault detection. • Role of SCADA in industry 4.0 and IIoT. • SCADA applications in water treatment, energy, and manufacturing.
7	**Flexible Manufacturing System (FMS)** • Introduction to FMS and its importance in modern manufacturing • Important Components of FMS, Advantages and Disadvantages of FMS • Applications of Pneumatics in Manufacturing • Use of Machine Vision, important components, sorting application • Pick and Place concept and its important components
8	**Overview of Manufacturing Execution Systems (MES)** • Introduction to manufacturing execution systems (MES) • ISA 88 AND ISA 95 • MES architecture and MES core functionalities. • Key functions of MES: production scheduling, quality control, tracking. • MES data flow and communication protocols • Real-time work order management in MES • Resource allocation via MES • MES reporting and dashboards for production insights • Barcode integration for MES automation • Exploring MES and industry 4.0: digital twin and smart manufacturing • Case study: MES implementation in a smart factory.

4. PRACTICALS

- Explain different safety tools & Kits, Hazard identification & avoidance, proper waste management.
- Demonstrate various components of the automation simulator panel.
- Demonstrate signal measurement using Multimeter
- Identifying and testing of different type of sensors
- Demonstrate wiring and testing of various output devices.
- Show on-off control using relays.
- Test Emergency stop and safety interlock
- Decode alarm and status indications.

- Configuring and opening PLC programming software.
- Use of basic commands and instructions.
- Demonstrate XIC, XIO, coil and addressing concept.
- Interfacing digital I/O with PLC.
- Configuring analog, I/O with PLC.
- Writing basic ladder logic programs
- Implementing start-stop logic using push buttons
- Design logic gates concept using ladder diagram.
- Design and practice various real time scenarios.
- Configuring and programming timers and counters.
- Create various programs based on timer's application.
- Create various programs based on timer, counter and comparators.
- Design a PLC program to execute the elevator system in a 3-floor apartment.
- Troubleshooting faulty I/O modules in a PLC system.
- Programming safety interlocks for emergency shutdown.
- Demonstration of buttons/keys present on VFD.
- Configuring basic VFD parameters for motor speed control.
- Implementing start/stop and forward/reverse operation
- Adjusting acceleration and deceleration ramp times.
- Interfacing VFD with PLC for automated speed control.
- Implementing emergency stop and safety interlocks.
- Analysing VFD faults and troubleshooting issues.
- Opening the HMI programming software.
- Designing HMI screens with buttons and indicators
- Configuring alarms and event logging in HMI
- Setting up data entry fields in HMI for operator input
- Creating HMI screens for tank level monitoring
- Implementing multi-screen navigation and setting up trends in HMI.
- Integration of HMI with PLC.
- Debugging HMI-PLC communication issues
- Demonstrate the SCADA software interface.
- Design program for a switch and a lamp and check out results in runtime.
- Designing start/stop control for pumps and motors via SCADA
- Configuring alarm management system with alerts
- Logging and retrieving historical data for analysis
- Creating live graphs and trend displays for process monitoring
- Interfacing SCADA with PLC, HMI and VFD for motor control applications
- Implementing data export and report generation in SCADA
- Using SCADA for batch processing and recipe management.
- Designing a SCADA simulation for a smart dashboard energy monitoring system.
- Integrate pneumatic systems, sorting, and pick and place.

- Configuring MES software for the first time.
- Setting up work order tracking in MES.
- Implementing barcode/RFIDs-based inventory management
- Creating automated production reports using MES dashboards.
- Setting up automated work scheduling for assembly line operations.
- Demonstrate integration of MES with PLC for process automation.
- Setting up role-based user access for MES data security.

Identify and resolve common issues in the MES assembly line like communication failure, alarms, equipment malfunction and data irregularity.

5.8	INDIAN CONSTITUTION	L T P 2 0 0

1. COURSE OBJECTIVES:

This course aims to help students understand the origin, development, and importance of the Indian Constitution. It introduces students to their fundamental rights and duties, while explaining the structure and functions of the legislature, executive, and judiciary in India. The course also promotes democratic values such as equality, justice, and the rule of law, and encourages students to develop a sense of responsible citizenship, civic awareness, and active participation in nation-building.

2. COURSE OUTCOMES (CO):

After successful completion of this course, the students should be able to

CO1: Understand the historical background, philosophy, and process involved in the making of the Indian Constitution.

CO2: Analyze the structure and functioning of the Union Government, including the roles, powers, and relationships of the President, Prime Minister, Council of Ministers, Lok Sabha, and Rajya Sabha.

CO3: Explain the organization and working of the State Government.

CO4: Evaluate the system of Local Administration in India by understanding the structure and functions of District Administration, Municipal Corporations, and Zila Panchayats.

CO5: Understand the role, powers, and significance of the Election Commission of India in ensuring free and fair elections in a democratic system.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	-	-	2	-	2	*	*
CO2	3	3	2	-	2	1	2	*	*
CO3	3	2	1	-	2	1	2	*	*
CO4	3	3	2	-	3	2	2	*	*
CO5	3	2	-	-	3	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. COURSE CONTENT

Unit 1 – The Constitution - Introduction **(6 Period)**

The History of the Making of the Indian Constitution, Preamble and the Basic Structure, and its interpretation, Fundamental Rights and Duties and their interpretation. State Policy Principles

Unit 2 – Union Government **(6 Period)**

Structure of the Indian Union, President – Role and Power, Prime Minister and Council of, Ministers Lok Sabha and Rajya Sabha

Unit 3 – State Government **(8 Period)**

Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat

Unit 4 – Local Administration **(4 Period)**

District Administration Municipal Corporation, Zila Panchayat

Unit 5 – Election Commission **(4 Period)**

Role and Functioning Chief Election Commissioner State Election Commission

5. RECOMENDED BOOKS:

S. No.	Title of Book	Author	Publication
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3.	Introduction to the Constitution of India	DD Basu	Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:

a. https://www.constitution.org/cons/india/const.html

b. http://www.legislative.gov.in/constitution-of-india

c. https://www.sci.gov.in/constitution

d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

6. SUGGESTED DISTRIBUTION OF MARKS

SR No	Topic Time Allotted (periods)	Marks Allotted %
1	6	21
2	6	21
3	8	28
4	4	15
5	4	15
TOTAL	28	100

6.1	ENTREPRENEURSHIP AND START-UP	L T P 2 0 0

1. 1. COURSE OBJECTIVES:

Explore the Objectives of Entrepreneurship, including innovation, wealth creation, and societal impact, and learn how Entrepreneurs foster economic growth. Entrepreneurship drives the economy and is the very fundamental to all innovation and development.

2. COURSE OUTCOMES (CO):

After successful completion of this course, the students should be able to

CO1: Understand the basic of Entrepreneurship and Business Structures

CO2: Planning and implementation of Business ideas

CO3: Understanding Strategical Market Analysis

CO4: Manage Organizational roles

CO5: Understanding various Financial schemes

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	1	-	-	-	2	*	*
CO2	2	3	3	2	1	3	2	*	*
CO3	2	2	2	2	1	-	2	*	*
CO4	2	1	2	-	2	3	2	*	*
CO5	3	2	2	2	2	1	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. COURSE CONTENT:

Unit 1 : **Introduction to Entrepreneurship and Start – Ups (02 Periods)**

- Definitions, Classification of Entrepreneur
- Traits of an Entrepreneur, Intrapreneurship, Motivation
- Types of Business Structures- On the Basis of size and On the basis of ownership

- Similarities/differences between entrepreneurs and managers

Unit 2 : **Business Ideas and their implementation** **(06 Periods)**

- Discovering ideas and visualizing the business
- Activity map
- Business Plan (Case Study)

Unit 3 :**Ideas to Start-up** **(06 Periods)**

- Marketing and Accounting- Definition and Importance.
- Market Analysis – STP (Segmentation, Targeting, Positioning)
- Competition evaluation and Strategy Development – Vision, Mission, Goal, Objectives.
- Risk analysis- SWOT Analysis.

Unit 4 : **Management** **(04 Periods)**

- Definition Concept and Functions of Management
- Company's Organization Structure- Concept and Classification
- Recruitment and Selection- Definition,
- Training and Development- Importance.

Unit 5 : **Financing and Protection of Ideas** **(10 Periods)**

- Financing methods available for Entrepreneurship/ Startups in India (Government Scheme, Banking, NBFCs, SHG and Micro Financing).
- Intellectual Property Rights- Overview of - Copyrights, Trademark, Geographical Indicators, Patenting and Licenses
- Communication of Ideas to potential investors – Investor Pitch.

Succession, Dissolution and Harvesting strategy**:** Ways of succession **,**Types of Dissolution

5. RECOMMENDED RESOURCES:

S. No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN – 978-0984999392
2.	Entrepreneurship Development (A new Venture creation)	Vasant Desai	Himalya Publication
3.	Entrepreneurship Development	Khanka S.S.	S Chand & Company Limited New Delhi
4.	Entrepreneurship Development	Gupta and Srinivsan	S Chand & Company Limited New Delhi
5	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN – 978-0755388974

6	The Lean Startup: How Today's Entre- preneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN – 978-0670921607
7	The Innovator's Dilemma: The Revolu- tionary Book That Will Change the Way You Do Business	Clayton M. Chris- tensen	Harvard business ISBN: 978-142219602

SUGGESTED SOFTWARE/LEARNING WEBSITES:

a. https://www.fundable.com/learn/resources/guides/startup
b. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/
c. https://www.finder.com/small-business-finance-tips
d. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/
e. NPTEL Course on Entrepreneurship https://onlinecourses.nptel.ac.in/noc23_mg74/preview
f. National Geographic Channel you tube Video on "GI Tag Crafts of Bharat"

6. INSTRUCTIONAL STRATEGY:

Introduce each unit with a structured exposition of fundamental concepts, definitions, and classifications, emphasizing the roles, traits, and functions of entrepreneurs and managers. Practical applications, including case studies, business plan development, market analysis, and risk assessment, shall be demonstrated to illustrate real-world entrepreneurial processes. Students shall engage in guided exercises, group activities, and simulations to apply theoretical knowledge in developing business ideas, strategies, and investor communication skills. Assessment shall be conducted through presentations, discussions, and project-based evaluations to monitor understanding, provide feedback, and cultivate entrepreneurial competence.

7. **SUGGESTED DISTRIBUTION OF MARKS:**

Topic No.	**Time Allotted (Periods)**	**Marks Allotted (%)**
1	2	17
2	6	14
3	6	20
4	4	17
5	10	32
Total	**28**	**100**

6.2.1	MANAGERIAL ECONOMICS (Theory)	L T P
		3 0 0

1. COURSE OBJECTIVES

To provide diploma students with a basic understanding of economic principles and how they are applied in business decision-making. The course aims to develop the ability to analyze and interpret economic data, understand market behavior, and make informed managerial decisions to optimize resources and improve business performance.

2. COURSE OUTCOMES(CO):

The theory should be taught in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes. After completion of the course the student will be able to.

CO1• Understand fundamentals of managerial economics and apply economic principles to business decisions.

CO2• Analyze demand, elasticity, and apply demand forecasting methods.

CO3• Explain production concepts and evaluate cost behavior and cost curves.

CO4• Identify different markets structures and analyze firm behavior under each market.

2. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO no.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	-	-	-	-	2	*	*
CO2	3	3	2	-	-	-	2	*	*
CO3	3	3	2	2	-	2	2	*	*
CO4	3	3	3	-	2	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

3. CONTENTS

UNIT 1- FUNDAMENTALS OF MANAGERIAL ECONOMICS (10 periods)

Nature and scope, meaning, goals and importance of managerial economics in business decision-making, Economic principles, Macroeconomics and Micro economics, Firm, nature and objective.

UNIT 2- DEMAND ANALYSIS AND FORECASTING (10 periods)

Theory of demand, factors influencing demand, and elasticity of demand, Demand Forecasting, Methods and techniques for forecasting demand.

UNIT 3- PRODUCTION AND COST ANALYSIS (12 periods)

Production, Production Function, Relationship between inputs and outputs, Production Analysis, Short-run and long-run production analysis, Law of Variable Proportions, Output behavior when one input varies and others are constant. Cost Analysis, Fixed cost, variable cost, total cost, marginal cost, average cost, Cost Curves.

UNIT 4- MARKET STRUCTURES (10 Periods)

Market Structures, Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly.

4. TEXT BOOKS/REFERENCE BOOKS

1. “Managerial Economics” by Dominick Salvatore

2. “Managerial Economics: Theory and Practice” by Thomas J. Webster

3. “Managerial Economics” by D. N. Dwivedi

4. “Managerial Economics and Financial Analysis” by Dr. N. Appa Rao & Dr. P. Vijay Kumar

6. INSTRUCTIONAL STRATEGY

This subject being of fundamental importance for diploma holders in electronics engineering and related fields, emphasis on conceptual understanding may be given by taking the help of charts.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	10	22
2	10	26
3	12	30
4	10	22
Total	42	100

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6.2.2	FINANCE FUNDAMENTALS (Theory)	L T P 3 0 0

1. COURSE OBJECTIVES

The objective of this course is to enable the student to identify different ways to save money for future, understand various techniques to raise capital, get acquainted with the essential terminologies used in finance language, get exposed to banking, credit, investments, assets, different types of budgeting, instill the concept of costing and its impact on profitability. It also encompasses study of money, banking, credit, investments, assets, liabilities that make up financial systems and improves overall financial literacy.

2. COURSE OUTCOMES(CO):

Students will be able to:

CO1: Manage financial resources effectively to achieve personal goals
CO2: Ensure that the business has enough money to meet its obligations and that it can recover in the future
CO3: Exhibit financial literacy through the usage of different terminologies appropriate to the context
CO4: Differentiate different types of budgeting and allocate the resources
CO5: Apply the idea of marginal costing in decision making

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	2	1	-	1	-	2	-	-
CO2	3	2	1	-	1	-	2	-	-
CO3	3	1	1	-	1	-	3	-	-
CO4	3	2	2	-	1	-	2	-	-
CO5	3	2	1	-	1	-	2	-	-

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENTS

UNIT-1 PERSONAL FINANCE (07 Periods)

Personal Finance – Meaning, Objectives and advantages – Individual Perspective – Family Perspective – Time Value of Money – Personal Savings: Meaning, Different modes of Saving – Bank Deposit, Online Investments, Insurance, Stocks, Gold, Real Estate – Returns Vs Risk – Financial Discipline – Setting Alerts for commitments (With Real time Examples)

UNIT-2 BUSINESS FUNDING (**07 Periods)**

Sources: Personal Savings – Borrowings - Venture Capital – Venture Capital Process – Commercial Banks – Government Grants and Scheme

UNIT-3 FINANCE LANGUAGE (**10 Periods)**

Capital – Drawing – Income – Expenditure – Revenue Vs Capital Items – Assets – Fixed Assets – Current Assets – Fictitious Assets – Liabilities – Long-term Liabilities – Current Liabilities – Internal Liabilities – External Liabilities – Share holders fund: Equity Share capital, Preference Share Capital, Reserve & Surplus – Borrowings: Debentures, Bank Loan, Other Loan – Depreciation – Reserve Vs Provision.

UNIT-4 BUDGETING (**08 Periods)**

Budgetary Control – Meaning – Preparation of various budgets – Purchase budget – Sales Budget – Production budget – Cash Budget – Flexible budgets. (With Problems)

UNIT-5 MARGINAL COSTING (**10 Periods)**

Marginal Costing – Meaning – Marginal Costing Vs Absorption Costing – Concepts of Variable Cost, Fixed Cost and Contribution – PV Ratio – Break Even Point – Margin of Safety – Key Factor – Application of Marginal Costing in decision making – Make or Buy – Shutdown or Continue – Exploring New Markets (With Problems)

5. TEXT BOOKS/REFERENCE BOOKS

1. S. K. Sharma, Fundamentals of Financial Management, Sultan Chand & sons, New Delhi, 2024

2. L. Natarajan, Banking Theory, Law & Practice, 1st edition, Margham Publications, 2019

3. T.S. Reddy and Dr. Y. Hariprasad Reddy, Management Accounting, 1st edition, Margham Publications, 2005

4. T.S. Reddy and Dr. Y. Hariprasad Reddy, Cost Accounting, 1st edition, Margham Publications, 2012

5.Web resource: **https://archive.nptel.ac.in/courses/110/107/110107144/**

6. INSTRUCTIONAL STRATEGY

This course gives a deep insight into the finance fundamentals such as money management and the process of acquiring needed funds. The teacher should actively engage students to boost their learning confidence, incorporate relatable, real-life examples and applications to help students understand and appreciate course concepts, utilize demonstrations and plan interactive student activities for an engaging learning experience. The teacher employs a theory-demonstrate-practice- activity strategy throughout the course to ensure outcome-driven learning and employability.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	7	17
2	7	17
3	10	23
4	8	20
5	10	23
Total	42	100

6.2.3	CYBER SECURITY (Theory)	L T P 3 0 0

1. COURSE OBJECTIVES

- Introduce the fundamentals of cyber security, threats, and ethical practices.
- Explain the basic principles of cryptography and data encryption techniques.
- Describe network vulnerabilities and methods to protect network infrastructures.
- Provide knowledge about web application vulnerabilities and security techniques.
- Develop understanding of security policies, audits, and ethical hacking practices.

2. COURSE OUTCOMES(CO):

CO1: Identify and describe cyber threats, attacks, and security principles.

CO2: Understand and apply cryptographic techniques for securing communication.

CO3: Analyze network vulnerabilities and implement network security measures.

CO4: Detect web application vulnerabilities and apply security best practices.

CO5: Explain cyber security management practices, laws, and ethical hacking concepts.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	1	2	2	1	2	3	2
CO2	3	3	2	2	2	1	2	3	2
CO3	3	3	2	3	2	2	2	3	3
CO4	3	3	3	3	2	2	2	3	3
CO5	3	2	1	2	3	3	3	2	2

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENTS

UNIT 1 – INTRODUCTION TO CYBER SECURITY (07 Periods)

Definition and Importance of Cyber Security, Cyber Threats and Attacks: Malware, Phishing, Ransomware, Social Engineering, Denial of Service (DoS) , Cyber Security Principles: Confidentiality, Integrity, Availability, Authentication, Non-repudiation

Cyber Security in Electronics and IoT: Security concerns in embedded systems, smart devices, and industrial control systems

Cyber Laws and Ethics: Overview of IT Act (2000), Data Protection Laws, Ethical Hacking

UNIT 2 – CRYPTOGRAPHY AND ENCRYPTION (10 Periods)

Introduction to Cryptography: Basics of encryption and decryption, Types of Cryptographic Algorithms: Symmetric (AES, DES), Asymmetric (RSA, ECC), Hash functions (MD5, SHA),

Public Key Infrastructure (PKI): Digital signatures, Certificates, Trust models,

Applications of Cryptography: SSL/TLS, Secure Email, VPNs, Blockchain

Cryptography in IoT and Embedded Systems: Key exchange protocols, securing communication between IoT devices

UNIT 3 – NETWORK SECURITY (07 Periods)

Introduction to Network Security: Concepts of firewalls, intrusion detection and prevention systems (IDS/IPS), Network Security Protocols: IPsec, SSL/TLS, HTTPS, SSH

VPNs and Proxies: Understanding Virtual Private Networks and Proxy Servers for secure communication

Securing Wireless Networks: Wireless security standards (WPA, WPA2, WPA3), threats to wireless networks

UNIT 4 – WEB AND APPLICATION SECURITY (09 Periods)

Web Application Vulnerabilities: XSS (Cross-Site Scripting), SQL Injection, CSRF (Cross-Site Request Forgery)

Web Security Measures: Web Application Firewalls (WAFs), Secure Coding Practices, Input validation

Secure HTTP (HTTPS): SSL/TLS in securing web traffic

Mobile and IoT Application Security: Securing mobile applications, secure communication in IoT

UNIT 5 – CYBER SECURITY MANAGEMENT AND ETHICAL HACKING
(09 Periods)

Cyber Security Policies and Risk Management: Establishing security policies, risk assessment, and mitigation strategies

Security Audits: Understanding how to conduct a security audit, common audit frameworks

Ethical and Legal Issues: Legal aspects of hacking, cybersecurity compliance, and international regulations

5. TEXT BOOKS/REFERENCE BOOKS

1. Cyber Security Essentials by Charles J. Brooks
2. Principles of Information Security by Michael E. Whitman and Herbert J. Mattord
3. Network Security Essentials by William Stallings
4. Introduction to Modern Cryptography by Jonathan Katz and Yehuda Lindell
5. Ethical Hacking and Penetration Testing Guide by Rafay Baloch
6. Cyber Security and Cyber Laws by S. B. S. K. Sharma (Indian Author)
7. Cyber Security: Understanding Cyber Crimes, Computer Forensics, and Legal Perspectives by Nishith Chhapparia (Indian Author)

5. INSTRUCTIONAL STRATEGY

1. Explain cyber threats using real-life examples (like phishing as fake messages) and show how electronics/IoT devices are affected.
2. Use simple locks-and-keys analogy to explain encryption and demo how data can be secured using basic coding tools.
3. Show network threats visually (like firewall as a security gate) and simulate basic attacks like packet sniffing in labs.
4. Teach common website attacks using demo websites and practice finding and fixing issues using safe simulation tools.
5. Use hacking demos (ethical only) to explain risks and teach how organizations protect data using audits and policies.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	**7**	**16**
2	**10**	**24**
3	**7**	**16**
4	**9**	**22**
5	**9**	**22**
Total	**42**	**100**

6.2.4	DATA SCIENCE (Theory)	L T P
		3 0 0

1. COURSE OBJECTIVES

- Learn the basics of Data Science and its use in electronics.
- Gain skills in collecting, cleaning, and analyzing data.
- Use Python with tools like NumPy and Pandas.
- Understand basic machine learning and how it applies to electronics.
- Apply data science in areas like IoT, automation, and signal processing.

2. COURSE OUTCOMES(CO):

CO1• Understand the basic concepts of Data Science, its scope, and its applications in the field of electronics.

CO2• Identify and handle different types of data and perform basic data visualization and statistical analysis.

CO3• Write Python programs for data processing using NumPy and Pandas with a focus on electronics datasets.

CO4• Apply basic machine learning techniques to solve problems related to electronics systems.

CO5• Analyze real-world data science applications in IoT and electronics and develop a mini-capstone project.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	1	1	-	-	2	3	2
CO2	3	3	2	2	1	-	2	3	2
CO3	3	3	2	3	-	-	2	3	3
CO4	3	3	3	3	1	1	2	3	3
CO5	3	3	3	3	2	3	3	3	3

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENTS

UNIT 1 – INTRODUCTION TO DATA SCIENCE (08 Periods)

What is Data Science? Evolution and Importance, Data Science vs. Data Analytics vs. Machine Learning,

Applications in Electronics: IoT, Automation, Signal Processing

Overview of Data Science Workflow

UNIT 2 – DATA HANDLING AND VISUALIZATION (08 Periods)

Types of Data: Structured, Unstructured, Time-Series, Data Collection Methods (from sensors, logs, APIs), Data Cleaning Techniques, Introduction to Excel and CSVs, Visualization with Matplotlib / Seaborne / Excel, Basics of Statistics (mean, median, mode, std. dev.)

UNIT 3 – PYTHON FOR DATA SCIENCE - (08 Periods)

Why Python for Data Science? Basics of Python Programming (variables, loops, functions) , Libraries: NumPy, Pandas – Data Manipulation , Reading sensor data from files , Mini project: Handling electronics-related datasets (e.g., temperature, voltage logs)

UNIT 4 – INTRODUCTION TO MACHINE LEARNING - (08 Periods)

Supervised vs. Unsupervised Learning, Algorithms Overview: Linear Regression, KNN, Decision Trees, Real-world examples in electronics (e.g., fault prediction, pattern detection), Model Training, Testing, and Evaluation .

UNIT 5 – REAL-WORLD APPLICATIONS OF DATA SCIENCE - (10 Periods)

Data Science in IoT & Smart Devices, Signal and Image Data Analysis Basics, Introduction to Big Data Concepts (brief) , Ethics in Data Science and AI , Capstone Project Guidelines

5. TEXT BOOKS/REFERENCE BOOKS

1. "Doing Data Science" by Cathy O'Neil & Rachel Schutt
2. "Data Visualization with Python and JavaScript" by Kyran Dale
3. "Python Data Science Handbook" by Jake VanderPlas
4. "Machine Learning for Absolute Beginners" by Oliver Theobald
5. "Data Science for IoT Engineers" by Perry Lea
6. Data Science & Machine Learning by Rashmi Singh

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6. INSTRUCTIONAL STRATEGY

1. Use simple analogies and real-life examples to explain what data science is. Show short videos or case studies from electronics applications like IoT or automation.
2. Start with live demos on types of data collected from sensors. Conduct hands-on sessions using Excel and Python for data cleaning and basic visualization.
3. Teach Python through interactive coding sessions using Jupyter Notebook. Begin with basic syntax, loops, and functions, then introduce NumPy and Pandas. Use small exercises focused on sensor or log data.
4. Introduce ML through simple, visual examples like predicting temperature or detecting faults. Compare supervised vs. unsupervised learning using relatable scenarios. Use tools like scikit-learn to build basic models in class.
5. Explain applications in IoT, smart devices, and image/signal analysis with real-world examples. Show industry videos or invite guest speakers to share insights. Touch on big data and ethics using simple language.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	**8**	**20**
2	**8**	**20**
3	**8**	**20**
4	**8**	**20**
5	**10**	**20**
Total	**42**	**100**

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6.3.1	MOBILE AND WIRELESS COMMUNICATION (Practicum)	L T P
		2 0 3

1. COURSE OBJECTIVES

Wireless and mobile communication technologies, though complex, are expanding at a rapid pace. Mobile communication has largely replaced traditional landline systems, and it is anticipated that mobile communication will become nearly universal in the near future. As the technology continues to evolve rapidly, it is essential for students to understand the functioning, architecture, and operational principles of wireless and mobile communication systems. This course aims to equip students with fundamental knowledge and practical understanding of wireless/mobile communication systems, enabling them to stay updated with current and emerging communication technologies.

2. COURSE OUTCOMES (CO):

The course is designed to develop students' learning across the cognitive, psychomotor, and affective domains**,** enabling them to achieve the following outcomes:

CO1• Identify and explain the features, specifications and working principles of cellular mobile communication systems.

CO2• Understand and explain the concepts of wireless signal propagation and its impact on communication performance.

CO3• Interpret the evolution and generations of cellular mobile communication systems.

CO4• Analyze and compare multiple access techniques used in wireless communication, such as FDMA, TDMA, and CDMA.

CO5• Differentiate between various mobile communication systems based on their architecture, standards, and applications.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	-	1	-	-	2	*	*
CO2	3	3	-	-	-	-	2	*	*
CO3	3	2	-	-	-	-	2	*	*
CO4	3	3	2	1	-	-	2	*	*
CO5	3	2	-	-	-	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENT

UNIT 1- WIRELESS COMMUNICATION AND PROPAGATION (06 Periods)

Basics, Advantages of wireless communication, Electromagnetic waves, Frequency Spectrum used, Cellular Network Systems, Link budget, Free-space path loss, Noise figure of receiver, Multipath fading, Shadowing, fading margin, Shadowing margin

Ex. No.	Name of Experiment	Hours
1.	To understand the path loss	2
2.	Understand the path loss with shadowing	2
3.	Understanding the Flat fading.	2
4.	Understanding the Frequency selective fading.	2
5.	Understanding the Multipath channel for the following objectives a. No Fading b. Flat Fading c. Dispersive Fading.	4-6

UNIT 2 - OVERVIEW OF CELLULAR SYSTEMS (08 Periods)

Evolution 1G/2G/3G/4G/5G

Cellular Concepts – Cell area, Cell site structure, Capacity of cell, Frequency reuse, Co-channel and Adjacent Channel Interference, Power Control for reducing Interference,

Fundamentals of cellular network planning: Coverage planning, Capacity planning, Cell splitting and sectoring

Antenna diversity, wireless channel capacity and MIMO

Ex. No.	Name of Experiment	Hours
1	Study the features, specification and working of cellular mobile.	4-6
2	To understand the cellular frequency reuse concept to find the co-channel cells for a particular cell.	4-6
3	To simulate a dipole antenna (λ, $\lambda/4$, $\lambda/2$, $3\lambda/2$) for a particular frequency using 4NEC2.	4

UNIT 3 -MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION (06 Periods)

Introduction to Multiple Access. Frequency Division Multiple Access (FDMA). Time Division Multiple Access (TDMA), Distinction between TDMA FDD and TDMA TDD, Code Division Multiple Access (CDMA), WCDMA

Ex. No.	Name of Experiment	Hours
1	Perform following experiments using CDMA trainer kit a. PSK modulation and demodulation experiment	2-4
	b. Bit synchronization extraction experiment	2-4
	c. Error correction encoding experiment	2-4

UNIT 4 - MOBILE COMMUNICATION SYSTEMS (8 periods)

Introduction of Global Systems for Mobile Communication (GSM) and its architecture, Introduction of CDMA System, comparison of CDMA and GSM Systems and frequency bands.

Introduction to GPRS and EDGE, Introduction to Architecture and Features of UMTS HSPA (High Speed Packet Access), Features and Architecture of LTE (Long Term Evolution), Vo-LTE (Voice Over Long-Term Evolution)

Ex. No.	Name of Experiment	Hours
1	Measurement of signal strength at various points from a transmitting antenna	4
2	Demonstration of Base Trans Receiver (BTS) with nearby cellular tower	2
3	Observing call processing of GSM trainer kit.	4
4	Repair of a GSM mobile phone	4
5	Troubleshooting GSM Mobile Phone a. Assembling and dissembling of GSM phone b. Study parts of Mobile Phone c. Testing of various parts	6

5. INSTRUCTIONAL STRATEGY

The teacher should lay stress on the concept of wireless propagation, cellular systems and multiple access techniques. The students must know about Bluetooth and Wi-Fi Technologies, and the various mobile communication system.

6.3.2	VLSI USING VHDL(Practicum)	L T P
		2 0 3

1. COURSE OBJECTIVES

Very Large Scale Integration (VLSI) technology plays a vital role in the design and implementation of modern digital systems. Hardware Description Languages (HDLs) provide a structured and efficient way to model, design, and verify digital hardware. This course aims to introduce students to the fundamentals of VLSI design using HDL, with emphasis on the design and analysis of combinational and sequential digital circuits. The course also focuses on simulation and functional verification of digital systems using the VHDL Hardware Description Language, and provides exposure to programmable logic devices such as CPLDs and FPGAs.

2. COURSE OUTCOMES

The course is designed so that theory and laboratory components together enable students to achieve the following learning outcomes:

After successful completion of the course, students will be able to:

CO1• Explain the concepts and operation of NMOS and CMOS logic circuits.

CO2• Describe the stages involved in the VLSI design process.

CO3• Understand and apply various VHDL constructs and statements.

CO4• Develop and simulate VHDL code for combinational and sequential digital circuits.

CO5• Demonstrate familiarity with CPLD and FPGA architectures and their applications.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO no.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO 2
CO1	3	2	-	-	-	-	2	*	*
CO2	3	2	1	-	-	-	2	*	*
CO3	3	2	-	2	-	-	2	*	*
CO4	3	3	3	3	-	-	2	*	*
CO5	2	2	2	3	-	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

5. CONTENT

UNIT 1- **(6 Periods)**

Levels of abstraction in VLSI design, Stages in the VLSI design process: Design Entry, Simulation, Synthesis, Placement, and Routing, Implementation of NOT, AND, OR, NAND, and NOR gates using NMOS, Implementation of NOT, AND, OR, NAND, and NOR gates using CMOS, Design of simple combinational circuits using NMOS, Design of simple combinational circuits using CMOS.

Ex. No.	Name of Experiment	Hours
1	Simulation of AND and OR gate using VHDL code.	

UNIT 2- **(06 Periods)**

Types of HDL, Various modeling techniques, Fundamentals of VHDL language: module, Data types, Operators: Arithmetic operators, Logical shift operators, Relational operators, Logical operators, Syntax for Continuous assignment statements, Procedural assignment statements, Timing control, wait statement, Syntax for control statements.

UNIT 3- **(06 Periods)**

VHDL code for Half Adder and Full Adder, VHDL code for Half Subtractor and Full Subtractor, VHDL code for 4-to-1 Multiplexer, 1-to-4 Demultiplexer, VHDL code for 4-to-2 Encoder, 2-to-4 Decoder.

Ex. No.	Name of Experiment	Hours
1	Simulation of half adder and full adder using VHDL	
2	Simulation of half subtractor and full using VHDL	
3	Simulation of 4x1 MUX using VHDL	
4	Simulation of 1x4 DMUX using VHDL	
5	Simulation of 4 to 2 encoder using VHDL	
6	Simulation of 2 to 4 decoder using VHDL	

Unit 4- **(6 Periods)**

VHDL code for D, JK, and T Flip-flops, VHDL code for 3-bit Shift register, VHDL code for 3-bit up counter, VHDL code for 3-bit down counter, VHDL code for 3-bit up-down counter.

Ex. No.	Name of Experiment	Hours
1	Write VHDL program for D, JK and T flip-flops	

2	Write VHDL program for 3-bit shift register	
3	Write VHDL program for 3-bit up counter	
4	Write VHDL program for 3-bit down counter	

UNIT 5- **(04 Periods)**

Introduction to PROM, PLA, and PAL – Design of combinational circuits using PROM, PAL, and PLA (up to 3 variables).

4. INSTRUCTIONAL STRATEGY

The subject requires both theory and practical emphasis simultaneously, so that the student can understand the practical significance of the various areas. Visits to instrumentation and communications industries must be carried out, so as to make the students can understand where and how the various instruments are used in the industry.

6.3.3	POWER ELECTRONIC DEVICES (Practicum)	L T P
		2 0 3

1. COURSE OBJECTIVES

The objective of this course is to introduce students to the fundamental concepts, principles, and applications of power electronics and power semiconductor devices. The course focuses on the working principles, characteristics, and applications of power semiconductor devices such as MOSFETs, IGBTs, and thyristors. It also aims to develop an understanding of the operation, analysis, and applications of power converters, including DC–DC converters (choppers) and inverters, with emphasis on their role in energy conversion systems. The course provides practical exposure through hands-on experiments and simulations involving power electronic circuits. Additionally, students are introduced to the integration of power electronic systems in renewable energy applications such as solar and wind energy, along with associated power quality considerations.

2. COURSE OUTCOMES (CO):

After successful completion of the course, students will be able to:

CO1● Explain the fundamental concepts of power electronics and the operating principles of power semiconductor devices such as MOSFETs, IGBTs, and thyristors, along with their real-world applications..

CO2● Analyze the characteristics and performance of power semiconductor devices and apply appropriate devices for specific power electronic applications.

CO3● Design, simulate, and analyze DC–DC power converters (choppers) and evaluate their role in energy conversion systems.

CO4● Design, simulate, and implement inverters and DC–DC converters, and explain their control strategies.

CO5● Apply power electronic systems in renewable energy applications such as solar and wind energy systems, and analyze power quality issues associated with these systems.

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	-	-	-	-	2	*	*
CO2	3	3	2	-	-	-	2	*	*
CO3	3	3	3	2	1	-	2	*	*
CO4	3	3	3	3	-	-	2	*	*
CO5	3	2	2	2	3	-	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

***** PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

4. CONTENT

UNIT -1 INTRODUCTION TO POWER ELECTRONICS AND POWER SEMICONDUCTOR DEVICES (06 Periods)

Introduction to Power Electronics: Definition, Basic concepts and Applications, Power Metal Oxide Semiconductor Field Effect Transistor (MOSFET)-N-channel Enhancement Power MOSFET, Insulated Gate Bipolar Transistor (IGBT)- Symbol, Principle of Working, Voltage-Current (V-I) Characteristics, and its applications.

Ex. No.	Name of Experiment	Hours
1	Explore the working principle and applications of an N-channel enhancement MOSFET.	3
2	Demonstrate the working principle and real-world applications of an IGBT.	3
3	Visualize the Voltage-Current (V-I) characteristics of IGBT.	3
4	Explore real-world applications of MOSFETs and IGBTs.	3

UNIT- 2 THYRISTOR FAMILY DEVICES (06 Periods)

SCR, DIAC, TRIAC, UJT – Symbol, working principle, Characteristics and applications.

Ex. No.	Name of Experiment	Hours
5	To study the characteristics and applications of an SCR and observe its switching behaviour.	3
6	To study the characteristics of the DIAC and observe its switching behaviour.	3
7	To study the characteristics and switching behaviour of a TRIAC and observe its use in controlling AC loads.	3
8	To study the characteristics of the UJT and use it in triggering applications like relaxation oscillators.	3

UNIT -3 CHOPPERS & CONVERTERS (05 Periods)

Introduction to DC-DC converters (Choppers), Working principle and classification of choppers : Step-up (Boost) Converter, Step-down (Buck) Converter, Buck-Boost Converter, Cuk Converter, Types of Choppers, Applications of Choppers. Single Phase Full Controlled Bridge Converter with R Load and RL load.

Introduction to Inverters, Types of inverters, Basic Operation, Control Strategies, Applications.

Ex. No.	Name of Experiment	Hours
9	Design and Simulation of a Boost Converter	3
10	Implement a simple application using a DC-DC converter, such as a power supply for a microcontroller.	3

UNIT -4 INVERTERS (05 Periods)

Introduction to Inverters, Types of inverters, Basic Operation, Control Strategies, Applications. Inverter with Resistive Load, Single Phase Inverter with RL load –Methods to obtain Sine Wave output from an Inverter.

Ex. No.	Name of Experiment	Hours
11	Design and Simulation of a Basic Inverter	3
12	Design and simulate a pure sine wave inverter.	3

UNIT 5, APPLICATIONS OF POWER ELECTRONICS IN RENEWABLE ENERGY SYSTEMS (06 Periods)

Solar Power Electronics: Solar cells, solar panels, and the working principle of photovoltaic systems, Power converters in solar systems: DC-DC converters, MPPT (Maximum Power Point Tracking), and solar inverters, Grid integration of solar power, Wind Power Electronics: Wind energy conversion systems and their components, Power electronics for controlling wind turbines and grid integration, Energy Storage Systems: Role of energy storage in renewable energy systems: Batteries, supercapacitors, and hybrid systems.

Power quality issues in renewable energy and their mitigation using power electronics.

Ex. No.	Name of Experiment	Hours
13	Study the characteristics of a solar panel and design an MPPT controller.	3
14	Design and implement a basic solar inverter.	3
15	Analyze a small wind energy conversion system with a focus on power electronics.	3

4. **INSTRUCTIONAL STRATEGY**

- Involve and Motivate: To increase students' confidence in their ability to learn, teachers should actively involve their students.
- Real-World Relevance: To aid students in comprehending and appreciating course contents, include realistic, real-life examples and engineering applications.
- Interactive Learning: To create an engaging learning environment, use demonstrations and organize interactive student activities.
- Application-Based Learning: To guarantee outcome-driven learning and employability, use a theory-demonstrate-practice-activity approach throughout the course.
- Simulation and Real-World Practice: Perform practical exercises and demonstrations in a simulated setting, moving into real-world situations where practical.
- Promote Critical Analysis: Create an atmosphere where students may objectively evaluate the results of experiments and examine possible causes of inconsistencies.

EVALUATION METHODOLOGY

1. EVALUATION METHOD for THEORY

	Internal Assessment (40 marks)				External Assessment (60 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Written Test**	**Written Test**	**Attendance and Assignments**	**Pre – Semester Examination**	**End Semester Examination**
Portion	2 units	2 units	Regularly	All units	All units
Duration1hr	1hr	1hr	-	3hrs	3hrs
Exam Marks	20	20	20	60	60
Converted to	10	10	15	15	60
Tentative Schedule	5^{th} Week	10^{th} Week	Regularly	12^{th} -13^{th} Week	

IA1 and IA2: A written assessment test worth 20 marks should be conducted for two units. The marks earned (20 marks) will be converted to 10 marks. The best of the two assessments will be evaluated for an internal 10-mark assessment.

IA3: Assignments given after the completion of each unit, along with attendance throughout the semester, will be assessed for a total of 15 marks.

IA4: The pre-semester examination should follow the end-semester examination question pattern. The marks should be adjusted to 15 for internal assessment.

2. EVALUATION METHOD for <u>PRACTICAL</u>

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Practical Test**	**Practical Test**	**Attendance and Practical Documentation**	**Practical Test and Quiz – Viva Voce**	**Practical Examination**
Portion	50% Practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	3 hrs	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th Week	

IA1 and IA2: Complete all exercises and experiments as outlined and retain them for the practical test. The test should be conducted in accordance with the evaluation scheme. The best of the two practical tests will be internally evaluated for a total of 20 marks.

IA3: Maintain a practical file for each exercise while ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, and practical test along with a valid certificate (Progress Card). This will be assessed for 20 marks.

IA4: The pre-semester practical examination, quiz, and viva-voce should follow the end-semester practical examination pattern, with marks adjusted to 20 for internal assessment.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Circuit Diagram	**5**
C.	Procedure and Connections	**10**
D.	Observation Table and Calculation	**10**
E.	Result and its Discussion, Conclusion	**10**
F.	Practical Test	**20**
	Total	**60**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Circuit Diagram	**5**
C.	Procedure and Connections	**5**
D.	Observation Table and Calculation	**5**
E.	Result and its Discussion, Conclusion	**10**
F.	Viva-Voce	**10**
	Total	**40**

3. EVALUATION METHOD for PRACTICUM (End Exam-Practical)

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	**IA 2**	**IA 3**	**IA 4**	
Mode	**Practical Test**	**Practical Test**	**Attendance and Practical Documentation**	**Micro Project**	**Practical Examination**
Portion	50% practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	Regularly	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th Week	

- **IA1 and IA2:** Complete all exercises and experiments as instructed and retain them for the practical test. The test should be conducted according to the evaluation scheme. The best of the two practical tests will be internally assessed for a total of 20 marks.
- **IA3:** Maintain a practical file for each exercise, ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be evaluated by 20 marks.
- **IA4:** Submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be assessed by both the laboratory supervisor and an internal examiner. This evaluation will contribute 20 marks.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Circuit Diagram	**5**
C.	Procedure and Connections	**10**
D.	Observation Table and Calculation	**10**
E.	Result and its Discussion, Conclusion	**10**
F.	Mini Project	**20**
	Total	**60**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Circuit Diagram	**5**
C.	Procedure and Connections	**5**
D.	Observation Table and Calculation	**5**
E.	Result and its Discussion, Conclusion	**10**
F.	Viva-Voce	**10**
	Total	**40**

4. EVALUATION METHOD for <u>PRACTICUM (End Exam-Theory)</u>

	Internal Assessment (40 marks)						External Assessment (60marks)
	IA 1		IA 2		IA 3	IA 4	
Mode	**Written Test**	**Practical Test**	**Written Test**	**Practical Test**	**Attendance and Practical Documentation**	**Pre Semester Examination and Micro Project**	**End Semester Examination**
Portion	2 units	Practical related to the units	2 units	Practical related to the units	All unit	All Practical	All unit
Duration	1hr	3hrs	1hr	3 hrs	3hrs	Regularly	3hrs
Exam Marks	10	20	10	20	60	60	60
	30		30				
Converted to	10		10		15	15	60
Tentative Schedule	5^{th} Week		10^{th} Week		Regularly	12^{th} -13^{th} Week	

IA1 and IA2: A written assessment test worth 10 marks should be conducted for two **UNIT**s. Complete all exercises and experiments as outlined and retain them for the practical test worth 20 marks. The practical test should be conducted in accordance with the evaluation scheme. The total marks earned (30 marks) will be converted to 10 marks. The best of the two assessments will be internally evaluated for a total of 10 marks.

IA3: Attendance and the pre-semester examination should follow the end-semester examination question paper pattern. The marks should be adjusted to 15 for internal assessment.

IA4: Maintain a practical file for each exercise. Submit the required documents for the practical file, quiz/viva-voice, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be assessed for 40 marks. Additionally, submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be evaluated by both the laboratory supervisor and an internal examiner. The total of 60 marks will be converted to 15 marks.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION FOR IA4

Part	Description	Marks Allotted
A.	Objective	**5**
B.	Circuit Diagram	**5**
C.	Procedure and Connections	**5**
D.	Observation Table and Calculation	**5**
E.	Result and its Discussion, Conclusion	**10**
F.	Attendance & Mini Project	**10**
	Total	**40**

LAB EQUIPMENT LIST

5.3 ELECTRONIC SYSTEM DESIGN AND EMBEDDED SYSTEM

Sr.No.	Equipment	Specification	Price(per item)	Qty
1	Aurdino Processor Daughter Boards	**Arduino Uno 328 Daughter board** (Microcontroller- ATmega328, Flash Memory-32 KB.SRAM - 2 KB (ATmega328), EEPROM- 1 KB (ATmega328).Clock Speed- 16 MHz, Operating Voltage- 5V. Digital I/O Pins- 2 box header (14 pins of which 6 provide PWM output. Analog Input Pins- On 1 box header (6 pins).Programming- USB Programming & SPI programming header).Reset - On board programming)	5000	6
2	**Miscellaneous loose items.**	Servo Motor Temperature sensor (Mq series) LDR (I2C light sensor) LED Potentiometer LM35 IC		

5.4 MECHATRONICS LAB

S. no.	Name of equipment	Totally qty	Price per item (Approx) in rupees	Total price
1	Automatic Water Level Controller Kit Includes float/ultrasonic sensors, solenoid valve, and pump	**04**	**25000.00**	**100000.00**
2	**PID Control System Trainer kit (**Study of P, PI, PID modes for speed/temperature control)	**04**	**450000.00**	**180000.00**
3	**Signal Conditioning Trainer (** Instrumentation amplifiers, filters, and isolators)	**04**	**30000.00**	**120000.00**
4	**Process Control Station :** Multi-process setup for flow, pressure, and level control	**01**	**280000.00**	**280000.00**
5	**Industrial Sensor Trainer Kit :** Includes Proximity (Inductive/Capacitive), Motion (PIR), Pressure, and LDR/Phototransistors	**02**	**60000.00**	**120000.00**
6	**Electric Actuator & Relay Kit** Solenoids, Latching/Solid-state relays, and Triggering circuits	**02**	**40000.00**	**80000.00**

7	**Motor Interface Trainer** Controls for Stepper, Servo, DC, and BLDC motors	**02**	**50000.00**	**100000.00**
8	PLC Trainer Kit	**01**	**120000.00**	**120000.00**
9	SCADA Software & Hardware Kit	**01**	**450000.00**	**450000.00**
10	CNC Trainer Lathe/Mill	**01**	**750000.00**	**750000.00**
11	**CNC Simulation Software** Multi-user license for troubleshooting and G-code testing	**01**	**200000.00**	**200000.00**
12	**Misc**	**-**	**100000.00**	**100000.00**

5.5 Microelectronics fabrication technology

S. No.	Equipment / Instrument	Specification / Purpose	Qty.	Approx. Cost (INR)
1	Cleanroom Facility	Class 1000 (or Class 100) with HEPA filtration	1	25,00,000
2	Laminar Air Flow Bench	Dust-free working environment	2	2,00,000 each
3	Glove Box	Handling moisture/oxygen-sensitive chemicals	1	4,00,000
4	Silicon Wafer Handling Kit	Wafer tweezers, wafer boxes, holders	5 Sets	20,000/set
5	Thermal Oxidation Furnace	SiO_2 layer growth on silicon wafers	1	12,00,000
6	Spin Coater	Photoresist coating on wafers	1	3,50,000
7	Hot Plate	Soft bake and hard bake of photoresist	2	50,000 each
8	Laboratory Oven	Drying and annealing applications	1	1,50,000
9	UV Mask Aligner	Photolithography and UV exposure	1	18,00,000
10	Photomask Set	Pattern transfer during lithography	5	20,000 each
11	Wet Etching Station	Chemical etching of wafers	1	4,00,000
12	Plasma Etcher / Reactive Ion Etcher (RIE)	Dry etching process	1	30,00,000
13	Thermal Diffusion Furnace	Dopant diffusion into silicon	1	10,00,000
14	Ion Implantation Simulator / Ion Implanter	Precise doping of semiconductor wafers	1	60,00,000
15	Rapid Thermal Annealing (RTA) System	Dopant activation after implantation	1	15,00,000
16	PVD System (Sputtering Unit)	Thin film deposition	1	30,00,000
17	CVD System	Chemical Vapour Deposition	1	40,00,000
18	Optical Microscope	Wafer inspection	2	1,50,000 each

19	Digital Microscope	Surface inspection and defect analysis	1	2,00,000
20	Wafer Thickness Measurement Gauge	Thickness measurement	1	2,00,000
21	Digital Multimeter	Electrical measurements	5	2,500 each
22	Regulated DC Power Supply	Experimental power source	2	15,000 each
23	Fume Hood	Safe chemical handling	1	3,00,000
24	Computer Workstations	Process simulation and CAD software	10	50,000 each
25	Semiconductor Process Simulation Software	Silvaco TCAD / Sentaurus / COMSOL (Educational License)	10 Licenses	As per License
28	PPE Kit	Lab coats, gloves, goggles, face shields	20 Sets	5,000/set

S. No.	Consumable	Purpose
1	Silicon Wafers	Device fabrication
2	Photoresist	Lithography
3	Photoresist Developer	Pattern development
4	Hydrofluoric Acid (HF)*	Oxide etching
5	Buffered Oxide Etchant (BOE)	Controlled oxide etching
6	Acetone	Cleaning
7	Isopropyl Alcohol (IPA)	Cleaning and drying
8	Deionized (DI) Water	Wafer rinsing
9	Dopant Sources (Boron, Phosphorus)	Thermal diffusion
10	High Purity Process Gases (N_2, O_2, Ar)	Oxidation, sputtering, CVD
11	Target Materials (Al, Cu, Ti, Au)	PVD deposition
12	Quartz Boats	Furnace processing
13	Cleanroom Wipes	Cleaning
14	Nitrile Gloves	Safety
15	Wafer Storage Boxes	Safe storage

6.3.1 MOBILE AND WIRELESS COMMUNICATION

Sl. No.	Equipment	Specifications	Quantity	Price (approx. for each unit)

1	Mobile Phone Trainer Kit(GSM)	Dual band 900 / 1800 MHz GSM / GPRS Modem. Data, SMS, Voice. Remote control by AT commands	2	25000
2	GSM Mobile	touch screen	2	10000
3	CDMA Trainer Kit	CDMA-Direct Sequence Spread-Spectrum (DSSS) Modulator, Demodulator; Baseband Modulation : BPSK / QPSK / OQPSK with output spectral shaping, Extensive monitoring : Receiver lock, Carrier frequency error, code lock, synchronization etc.	2	45000
4	SIM card	As per requirement	1	
5	CRO/DSO	20MHz,dual trace, dual beam including various probes	2	55000
6	Spectrum Analyzer	upto 3GHz	1	150000
7	Digital Multimeter	DC Voltage : 0.1mV~1000V, AC Voltage : 0.1mV~750V, DC Current : 0.1uA~20A, AC Current : 0.1uA~20A, Ressistance : 0.1ohm~40MOhm	4	10000
8	NEC based antenna modeler and optimizer - 4nec2	Student Version	2	LS
9	Desktop latest configuration (Intel i3 processor)	8th Generation Minimum processor speed 3.0 GHz RAM 4GB DDR4, Min 6 MB, cache HDD 1TB, Networking Integrated Bluetooth 4.0 and wireless LAN 802.11b/g/n CD/DVD disk drive, USB Keyboard & USB,optical mouse, Monitor 18.5 inches or above, Ports HDMI 01 slot, VGA 01 slot, USB 2.0 minimum 4 slots, USB 3.0 minimum 2 slots, Integrated Intel HD graphics, headphones with mic, Webcam : HD Webcam, OS – Windows 10 professional Or Higher Specifications available	2	40000 (each)
10	MATLAB Software	Student Version	2	LS

6.3.2 VLSI USING VHDL

Sl.	Equipment	Specifications	Quantity	Price

No.				(approx.)
1	Desktop latest configuration (Intel i3 processor)	8th Generation Minimum processor speed 3.0 GHz RAM 4GB DDR4, Min 6 MB, cache HDD 1TB, Networking Integrated Bluetooth 4.0 and wireless LAN 802.11b/g/n CD/DVD disk drive, USB Keyboard & USB, optical mouse, Monitor 18.5 inches or above, Ports HDMI 01 slot, VGA 01 slot, USB 2.0 minimum 4 slots, USB 3.0 minimum 2 slots, Integrated Intel HD graphics, headphones with mic, Webcam : HD Webcam, OS – Windows 10 professional Or Higher Specifications available	15	40000 (each)
2	UPS	5KVA online at least 30 min backups	1	85000
3	Computer chairs and tables.		15 Table and 60 chairs	300000
4	AC for Lab	As per requirement	LS	LS
5	Laser printer (Network Printer).		1	15000
6	Circuit Logix Software (Student Version).		15 user	25000($295 USD) .

6.3.3 POWER ELECTRONIC DEVICES LAB

S. no.	Name of equipment	Totally qty	Price per item (Approx) in rupees	Total price
1	Digital Storage Oscilloscope (DSO): 2-channel or 4-channel (minimum 50MHz)	04	50000.00	200000.00
2	Digital Multimeters (DMM)	04	5000.00	20000.00
3	Isolation Transformer, 1:1 Ratio, 500VA (Safety for AC experiments)	02	35000.00	70000.00
4	Variable DC Power Supply 0-30V, 5A (Linear/Regulated)	04	20000.00	80000.00
5	LCR Meter	04	25000.00	100000.00
6	Power Semiconductor Characteristics Trainer kit (Thyristors (SCR/TRIAC/DIAC))	04	25000.00	100000.00
7	UJT Relaxation Oscillator & Firing Kit	04	25000.00	100000.00
8	DC-DC Boost & Buck Converter Trainer	04	30000.00	120000.00
9	Solar PV Module (50W) with MPPT Trainer	04	50000.00	200000.00
10	Pure Sine Wave Inverter Study Trainer	04	20000.00	80000.00
11	Small Wind Turbine Model	02	15000.00	30000.00
12	Assorted Semiconductors - MOSFETs, IGBTs, SCRs (Sets of 10)	-	-	50000.00

13	Misc - Breadboards & Patch Cords, Microcontrollers etc	-	-	50000.00