Curriculum

Three Year (Six Semesters) Diploma Course In

ELECTRONICS ENGINEERING

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3rd Semester to 4th 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.

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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

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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.

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I.R.D.T. Kanpur

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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** 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
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 (6th 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.

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.

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 -

---

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 combinational and 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
THIRD 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	
3.1	ELECTRONIC DEVICES AND CIRCUITS	PROGRAM CORE (THEORY)	03	-	-	3	40	-	40	60	3	-	-	60	100
3.2	DIGITAL ELECTRONICS	PROGRAM CORE (THEORY)	03	-	-	3	40	-	40	60	3	-	-	60	100
3.3	LINEAR INTEGRATED CIRCUIT	PROGRAM CORE (PRACTICUM)	02	-	02	3	40	-	40	60	3	-	-	60	100
3.4	ELECTRIC CIRCUIT AND NETWORK	PROGRAM CORE (PRACTICUM)	02	-	02	3	-	60	60	-	-	40	3	40	100
3.5	ELECTRONIC DEVICES AND CIRCUITS (LAB)	PROGRAM CORE (PRACTICAL)	-	-	04	2	-	60	60	-	-	40	3	40	100
3.6	DIGITAL ELECTRONICS (LAB)	PROGRAM CORE (PRACTICAL)	-	-	04	2	-	60	60	-	-	40	3	40	100
3.7	**(Q)** OPEN ELECTIVE-1 **OR**	OPEN ELECTIVE (THEORY)	02	-	-	2	50	-	50	-	-	-	-	-	N/A
	*ADVANCE SKILL DEVELOPMENT	OPEN ELECTIVE (Certification Course)					-	-	-	-	-	-	-	-	N/A
3.8	SUMMER INTERNSHIP** (4 Weeks after 2nd semester)	-	-	-	-	2	-	50	50	-	-	-	-	-	50
	#Student Centered Activities	-	-	-	12	-	-	50	50	-	-	-	-	-	50
	TOTAL	**-**	**12**	**-**	**24**	**20**	**120**	**280**	**400**	**180**	**-**	**120**	**-**	**300**	**700**

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 **3.7** 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 (4-6 WEEKS) duration to be organized after second semester exam. Evaluation will be in third 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.

FOURTH 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	
4.1	MICROPROCESSOR AND ITS APPLICATIONS	PROGRAM CORE (THEORY)	03	-	-	3	40	-	40	60	3	-	-	60	100
4.2	PRINCIPLES OF ELECTRONIC COMMUNICATION	PROGRAM CORE (THEORY)	03	-	-	3	40	-	40	60	3	-	-	60	100
4.3	ELECTRONIC INSRUMENTATION AND MEASUREMENT	PROGRAM CORE (PRACTICUM)	02	-	02	3	40	-	40	60	3	-	-	60	100
4.4	PROGRAMMING IN C	PROGRAM CORE (PRACTICUM)	01	-	04	3	-	60	60	-	-	40	3	40	100
4.5	MICROPROCESSOR AND ITS APPLICATIONS	PROGRAM CORE (PRACTICAL)	-	-	06	3	-	60	60	-	-	40	3	40	100
4.6	PRINCIPLES OF ELECTRONIC COMMUNICATION	PROGRAM CORE (PRACTICAL)	-	-	06	3	-	60	60	-	-	40	3	40	100
4.7	**(Q)** OPEN ELECTIVE-2 **OR**	OPEN ELECTIVE (THEORY)	02	-	-	2	50	-	50	-	-	-	-	-	N/A
	*ADVANCE SKILL DEVELOPMENT	OPEN ELECTIVE (Certification Course)					-	-	-	-	-	-	-	-	N/A
4.8	**(Q)** ESSENCE OF INDIAN KNOWLEDGE AND TRADITION	AUDIT COURSE	02	-	-	-	50	-	50	-	-	-	-	-	N/A
	#Student Centered Activities	-	-	-	05	-	-	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 **4.7** 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 (4-6 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.

OPEN ELECTIVE-1

SR.NO.	(Q) THEORY COURSES NAME
1.	PRODUCT DESIGN AND DEVELOPMENT
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
7.	COURSES CONDUCTED BY NEILIT

OPEN ELECTIVE -2

SR.NO.	(Q) THEORY COURSES NAME
1.	ELECTRIC VEHICLE
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
7.	COURSES CONDUCTED BY NEILIT

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/NSS activities 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.

3.1	ELECTRONICS DEVICES AND CIRCUITS (Theory)	L T P
		3 0 0

1. COURSE OBJECTIVES

This course will enable students to develop the skills required to use basic electronic devices in various electronic circuits. Through the study of this course the students will understand the construction, working, characteristics and applications of various types of semiconductor devices such as Diodes and transistors, which are basic building block of amplifier, oscillator, switching circuit, wave shaping circuit and power supply. The knowledge of this core subject is essential for comprehending the courses that will be introduced later in the diploma program as well as developing requisite skills for effective functioning in the industry.

2. COURSE OUTCOMES(CO):

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following COURSE OUTCOMES.

Students will be able to

CO1 • Explain the working of different semiconductor devices.

CO2 • Measure and calculate various parameters of different semiconductor devices.

CO3 • Conclude VI characteristics of various semiconductor devices.

CO4 • Explain the working of different type of amplifier and design a specific operating frequency of an oscillator.

CO5 • Compare SCR, DIAC, TRIAC and IGBT

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	-	-	-	-	-	-	*	*
CO2	3	3	-	2	-	-	-	*	*
CO3	3	2	-	3	-	-	-	*	*
CO4	3	3	3	-	-	-	-	*	*
CO5	3	1	-	-	-	-	-	*	*

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- SEMICONDUCTOR DIODES CIRCUIT AND APPLICATIONS (06 Periods)

Definition, Extrinsic/Intrinsic, N-type & p-type, P-N junction diode forward & reverse bias characteristics. Different types of diodes, Diode (P-N Junction) as rectifier, Half wave rectifier, full wave rectifier. Construction & Working Principle of Positive, Negative, and Biased Clippers - Construction & Working Principle of Positive and Negative Clampers

UNIT 2- BIPOLAR JUNCTION TRANSISTOR (11 Periods)

PNP and NPN transistor- Operation and characteristics. CB, CE and CC configurations: working, characteristics and their comparison. Concept of leakage current, effect of temperature on leakage current, standard notation for current and voltage polarity. Transistor Biasing, Transistor as an amplifier in CE configuration, DC load line.

UNIT 3- UNIPOLAR JUNCTION AND FIELD EFFECT TRANSISTOR (9 Periods)

Junction Field Effect Transistor: Construction, operation, characteristics and Biasing.
MOSFET: Construction, operation, Characteristics.
CMOS: Construction, operation and Characteristics
Comparison of JEET, MOSFET and Bipolar Transistor.
Introduction to advance non-planer devices like FinFET, GAA.

UNIT 4–AMPLIFIERS AND OSCILLATORS (11 Periods)

Single Stage Transistor Amplifier: Analysis of Single Stage CE, CB and CC amplifier.

Multistage Amplifiers: Need of multistage amplifier, gain of multistage amplifier, RC coupled, and transformer coupled, direct coupled Amplifier, their frequency response and bandwidth. Large Signal Amplifier: Difference between voltage and power amplifiers - Importance of impedance matching in amplifiers - Class A, Class B, Class AB, and Class C amplifiers, Push-pull amplifier.
Feedback Amplifiers: Properties of negative Feedback, impact of feedback on different parameters, Basic Feedback Amplifier Topologies.
Basic Principles, different types of Oscillator-LC, RC and crystal oscillator.

UNIT 5- SCR, DIAC, TRIAC and IGBT (05 Periods)

Construction, working and characteristics, SCR as a Switch, DIAC as bidirectional switch, Comparison of SCR, DIAC, TRIAC, MOSFET and IGBT.

5. TEXT BOOKS/REFERENCE BOOKS:

1. Analog Circuits A.K. Maini Khanna Publishing House Ed. 2018 (ISBN: 978-93-86173-584)
2. Electronic Devices and Circuits. Salivahanan and N. Suresh Kumar McGraw Hill Education; Fourth edition (1 July 2017) ISBN: 978-9339219505
3. Electronics Devices and circuit theory Boyestad & Nashelsky Pearson Education India; 11 edition (2015) ISBN: 978-9332542600

4. Electronic Principles Albert Malvino & David Bates Tata McGraw Hill Publication 2010 ISBN: 978-0070634244
5. Electronics Devices & Circuits Jacob Millman McGraw Hill Education;4 editions (2015) ISBN: 978-9339219543

6. INSTRUCTIONAL STRATEGY

Electronic Components & Devices being a fundamental subject, it needs to be handled very carefully and in a manner such that students develop clear understanding of the related concepts and principles. The teacher may lay more emphasis on laboratory work and give home assignments to students to inculcate self-study and problem-solving abilities amongst them.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	6	14
2	11	25
3	9	21
4	11	25
5	5	14
Total	42	100

3.2	DIGITAL ELECTRONICS (Theory)	L T P
		3 0 0

1. COURSE OBJECTIVES

Digital electronics plays significant role in revolution of Electronics industries. The major focus of the course is to expose students to design process of combinational and sequential logic circuits. This course gives profile to work in hardware industries, process industries. It gives strong foundation to all modern electronics devices and digital systems.

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.

Students will be able to

CO1 • Convert numbers from one numbering system to other.

CO2 • Deduce Boolean expressions for modelling a situation.

CO3 • Simplify Boolean expressions using K-map.

CO4 • Design and implement combinational circuits and Sequential circuits

CO5 • Classify memories on the basis of working principle, mode of access, physical characteristics etc.

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	-	-	-	-	-	-	*	*
CO2	3	3	-	2	-	-	2	*	*
CO3	3	2	-	3	-	-	-	*	*
CO4	3	2	3	-	-	-	-	*	*
CO5	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. COURSE CONTENTS

UNIT 1 – NUMBER SYSTEMS & BOOLEAN ALGEBRA (08 Periods)

Introduction to different number systems – Binary, Octal, Decimal, Hexadecimal. Conversion between the number system, 1's complement and 2's complement, Binary Addition and Subtraction. Special Codes: BCD, Gray Codes, ASCII codes.
Boolean Algebra: Basic Boolean laws, De-Morgan's Theorem, SOP and POS representation

UNIT 2 – LOGIC GATES (08 Periods)

Logic Gates – NOT, AND, OR, NAND, NOR, XOR, XNOR: Symbol, Logical expression and truth table. Implementation of Boolean expressions and Logic Functions using gates; Simplification of Boolean expressions using Karnaugh Maps (up to 4 variables).

UNIT 3 – COMBINATIONAL LOGIC CIRCUITS (08 Periods)

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer – 2 to 1 MUX, 4 to 1 MUX, 8 to 1 MUX., Demultiplexer – 1 to 2 DEMUX, 1 to 4 DEMUX, Decoder, Encoder. Parity generator and checker.

UNIT 4 – SEQUENTIAL LOGIC CIRCUITS (10 Periods)

Basic Latches using NAND and NOR gates, Triggering and types of triggering

Flip Flops – SR, JK, T, D Flip Flops, JK-MS Flip Flops,

Counters – Definition and types of counters, difference between asynchronous and synchronous counters, logic diagram, truth table and operation of Decade Counter, Johnson Counter and Ring Counter, applications of counters

Registers –: Types of register, Serial in Serial Out, Serial in Parallel Out, Parallel in Serial Out, Parallel in Parallel Out, applications of registers

UNIT 5 – MEMORY DEVICES (08 Periods)

Classification of Memories – RAM Organization, Address Lines and Memory Size, SRAM, DRAM,
Read Only memory – ROM organization, PROM, EPROM, EEPROM, Flash memory.
Data Converters – Introduction: Digital to Analog converters, Analog to Digital Converters.

5. TEXT BOOKS/REFERENCE BOOKS:

1. Digital principles & Applications Albert Paul Malvino& Donald P. Leach McGraw Hill Education; Eighth edition ISBN: 978-9339203405

2. Digital Electronics Roger L. Tokheim Macmillian McGraw-Hill Education (ISE Editions);

   International 2 Revised edition ISBN: 978-0071167963

3. Digital Electronics – an introduction to theory and practice William H. Gothmann Prentice Hall India Learning Private Limited; 2 edition ISBN: 978-8120303485

4. Fundamentals of Logic Design Charles H. Roth Jr. Jaico Publishing House; First edition ISBN: 978-8172247744

5. Digital Electronics R. Anand Khanna Publications, New Delhi

(Edition 2018) ISBN: 978-93-82609445

6. INSTRUCTIONAL STRATEGY

An effective strategy for digital electronics theory involves clear explanations of concepts like logic gates and Boolean algebra, supported by visual aids and diagrams. Encourage active learning through problem-solving, discussions, and real-world examples.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	08	19
2	08	19
3	08	19
4	10	24
5	08	19
Total	42	100

3.3	LINEAR INTEGRATED CIRCUIT (Practicum)	L T P 2 0 2

1. COURSE OBJECTIVES

The fundamentals of operational amplifiers and their linear and non-linear applications are covered in this course. Applications for operational amplifiers include signal conditioning circuits, medical electronics, and instrumentation. An operational amplifier is essential to the functionality of many different electrical circuits. Students who take this course will gain the skills necessary to maintain linear electronic circuits based on integrated circuits.

2. COURSE OUTCOMES(CO):

It is important to teach theory and conduct practical exercises in a way that enables students to exhibit the following course results by gaining various learning outcomes in the cognitive, psychomotor, and affective domains. The ability for students to:

CO1 • Illustrate the fabrications process of the various IC by the semiconductor industry.

CO2 • Compare electrical parameters of Ideal and practical OP-AMP

CO3 • Design of various electronic circuits based on OP-AMP

CO4 • Construct various voltage regulator IC.

CO5 • Illustration of various timer ICs.

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	-	-	-	-	-	-	*	*
CO2	3	2	-	2	-	-	-	*	*
CO3	3	3	2	2	-	-	-	*	*
CO4	2	2	2	2	-	-	-	*	*
CO5	2	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. CONTENT

UNIT 1- OPERATIONAL AMPLIFIERS (6 Periods)

Symbol, pin diagram, ratings of IC 741, Electrical properties, transfer characteristics & parameters of ideal OP AMP, DC and AC performance characteristics, slew rate, Open and closed loop configurations, Block diagram & operating principle, OP-AMP with positive and negative feedback.

Ex. No.	Name of Experiment	Periods
1.	To Interpret the parameters of given Op-Amplifier from data sheet	2
2.	To test performance of OP_AMP as an inverting & Non inverting amplifier and observe input/output waveforms. To test performance of OP_AMP as unity gain amplifier	2

UNIT 2- APPLICATIONS OF OPERATIONAL AMPLIFIERS (4 Periods)

Open loop configuration–Inverting, Non-inverting, Close loop configuration –Inverting, non- inverting, Differential amplifier, unity gain amplifier, Inverting & non-inverting configuration of Adders (summing, scaling, averaging amplifier), Subtractor, Integrator & Differentiator

Ex. No.	Name of Experiment	Periods
3.	To design and test performance of OP_AMP as an Adder and Subtractor	2
4.	To test performance of OP_AMP as an Integrator & Differentiator	2
5.	To test performance of OP_AMP Instrumentation Amplifier calculate gain & frequency response	2
6.	To build & test Astable multivibrator using IC 741 for different values of R and C.	2
7.	To build/test Monostable multivibrator using IC 741 for different values of R and C.	2

UNIT 3- SPECIAL PURPOSE OPERATIONAL AMPLIFIERS (6 Periods)

Bridge amplifier, instrumentation amplifier with two & three OP AMPS, V-I converters, I-V converters, logarithmic & Antilogarithmic amplifier, Astable, Monostable and Bistable Multivibrator using OP AMP.

Ex. No.	Name of Experiment	Periods

8.	To build & test fixed/variable voltage regulator using LM723 & plot line/ load regulation characteristics	2
9.	To build & test variable voltage regulator using LM317 & measure the dropout voltage & plot line/ load regulation characteristics.	2
10.	To build & test variable voltage regulator using LM337 & measure the dropout voltage & plot line/ load regulation characteristics.	2

UNIT 4- VOLTAGE REGULATOR (6 Periods)

Linear voltage regulator: Block schematic, pin diagrams, features, Specifications, rating and operating principle of IC 723, 78xx, 79xx series, switching regulator: Block schematic, pin diagram, features, specifications, ratings and operating, Principle of switching regulator IC LM 317, LM337 Regulator.

Ex. No.	Name of Experiment	Periods
11.	To build & test voltage regulator using 78xx and 79xx and measure the dropout voltage & plot line/ load regulation characteristics..	2
12.	To build Op-Amp as voltage Regulator- IC 723	2

UNIT 5- COMPARATOR AND TIMERS (6 Periods)

Op-Amp as comparator, Study of Op-amp peak to peak detector, phase detector circuit, voltage level detector circuit, Schmitt trigger using op-amp, Study of timer IC – 555, Block diagram, operating principle, pin diagram, Features of IC-555, IC-555 as Astable, Monostable, bi-stable & Schmitt Trigger, Sample and hold circuit, Phase Locked Loop-Principle & block diagram of PLL, Transfer characteristics, lock range & capture range.

Ex. No.	Name of Experiment	Periods
13.	Various applications of Timer IC555.	4

5. TEXT BOOKS/REFERENCE BOOKS:

1. Design with operational amplifiers and analog integrated circuits, 3rd Edition Sergio Franco Tata McGraw-Hill, 2007
2. Linear Integrated Circuits, D.Roy Choudhry, Shail Jain New Age International Pvt. Ltd
3. System design using Integrated Circuits. B.S.Sonde New Age Pub, 2nd Edition, 2001
4. Analysis and Design of Analog Integrated Circuits Gray and Meyer Wiley International, 2005.
5. OP-AMP and Linear ICs Ramakant A. Gayakwad Prentice Hall / Pearson Education, 4th Edition, 2001
6. Operational Amplifier and Linear Integrated Circuits K Lal Kishore, Pearson Education, 2006

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. Sufficient exercises may have given to the students in single stage and multi-stage amplifier circuits in addition to simple exercises in fabricating and testing of various simple DC circuits. The students may be encouraged to perform some additional practical exercises apart from the list provided.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	6	21
2	4	16
3	6	21
4	6	21
5	6	21
Total	28	100

3.4	ELECTRIC CIRCUITS AND NETWORK (Practicum)	L T P 2 0 2

1. COURSE OBJECTIVES

The study of networks, filters and transmission lines leads to understanding of line communication, audio and video communication, and microwave communication. Particularly the study of networks takes off from principles of A.C. theory and introduces the student to parameters and characteristics of various networks, including filters. Also the study of transmission lines becomes important as its analogy is used in study of transmission of plane electromagnetic waves in bounded media.

2. COURSE OUTCOMES(CO):

CO1 • Illustrate the concept of different networks
CO2 • Outline the Two networks
CO3 • Examine the operation of attenuators
CO4 •Examine the operation of filters
CO5 • Examine the concept of Transmission Lines

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	3	2	1	-	-	2	3	3
CO2	3	3	2	1	-	-	2	3	3
CO3	3	3	2	3	-	-	2	3	3
CO4	3	3	3	3	-	-	2	3	3
CO5	3	2	3	1	-	-	2	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. CONTENT

UNIT 1- BASIC ELECTRICAL CIRCUITS& THEOREM (06 Periods)

Node and Mesh analysis, Superposition Theorem, Thevenin Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem.

Ex. No.	Name of Experiment	Periods
1.	Verify voltage and current using Node analysis in a DC resistive circuit.	2
2.	Verify voltage and current using Mesh analysis in a DC resistive circuit.	2
3.	Verification of electrical circuit using Thevenin's theorem.	2
4.	Verification of electrical circuit using Norton's theorem.	2
5.	Verification of electrical circuit using Maximum Power Transfer theorem.	2
6.	Use Superposition theorem to determine current/voltage in a linear circuit with multiple sources.	2

UNIT 2- TWO PORT NETWORK (05 Periods)

Two Port Network: Open Circuit Impedance Parameters, Short Circuit Admittance Parameters, Transmission Parameters Hybrid Parameters.

Overview of T network, π network, Ladder network; Lattice network

Ex. No.	Name of Experiment	Periods
7.	Determine Z-parameters of a two-port network.	1
8.	To determine the Y parameters of a Two-port network	1
9.	Determine transmission line parameters A, B, C, and D of a two-port network.	1
10.	To determine Hybrid parameters of a Two-port network.	1

UNIT 3- ATTENUATOR (06 Periods)

Units of attenuation (Decibels and Nepers): General characteristics of attenuators - Analysis and design of simple attenuator of following types; Symmetrical T and π type, L type.

Ex. No.	Name of Experiment	Periods
11.	To design and verify a symmetrical T-type attenuator for a given attenuation and characteristic impedance.	1

12.	To design and verify a symmetrical π-type attenuator for a specified dB loss and characteristic impedance.	1

UNIT 4- FILTER (06 Periods)

Brief idea of the use of filter networks in different communication systems, concept of low pass, high pass, band pass and band stop filters. Active Filters Basic concept of active filters and their comparison with passive filters.

Ex. No.	Name of Experiment	Periods
13.	To study the frequency response of a Low Pass Filter and observe the cut-off frequency.	1
14.	To study the frequency response of a High Pass filter and observe the cut-off frequency	1
15.	To study the frequency response of a Band Pass filter and observe the cut-off frequency	2
16.	To study the frequency response of a Band Stop filter and observe the cut-off frequency	2
17.	To construct and test a Band Pass Filter and study its center frequency and bandwidth.	2

UNIT 5- TRANSMISSION LINE (05 Periods)

Transmission Lines, their types and applications, Distributed constants, T and π representation of transmission line section, Concept of reflection and standing waves, definition of reflection coefficient, SWR &VSWR and their relation (no derivation), Concept of transmission lines at high frequencies.

Ex. No.	Name of Experiment	Periods
18.	To observe reflections due to impedance mismatch in transmission lines.	2

5. TEXT BOOKS/REFERENCE BOOKS*:*

1. Network Filters and Transmission Lines by AK Chakarvorty; Dhanpat Rai and Co. Publication, New Delhi
2. Networks and Systems by Ashfaq Husain, Khanna Publishing House
3. Network Analysis by Soni and Gupta; Dhanpat Rai and Co. Publication, New Delhi
4. Network Filters and Transmission Line by Yash Pal; Ishan Publications, Ambala City

5. Electrical and Electronics Measuring instrumentation, A.K Sawhney; Dhanpat Rai and Co. Publication, New Delhi

6. INSTRUCTIONAL STRATEGY

Stress should be laid on problems in networks/ filler and transmission lines. Practical must be carried out after completion of topic to gain a good know how on the subject students should be given home assignments on various topics, stress on making own circuit models to calculate input/output impedance, characteristic impedance, losses etc. should be carried out by the students.

3.5	ELECTRONIC DEVICES AND CIRCUITS (Practical)	L T P 0 0 4

1. COURSE OBJECTIVES

This course will enable students to develop the skills required to use basic electronic devices in various electronic circuits. Through the study of this course the students will understand the construction, working, characteristics and applications of various types of semiconductor devices such as Diodes and transistors, which are basic building block of amplifier, oscillator, switching circuit, wave shaping circuit and power supply. The knowledge of this core subject is essential for comprehending the courses that will be introduced later in the diploma program as well as developing requisite skills for effective functioning in the industry.

2. COURSE OUTCOMES (CO):

The practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

Students will be able to

CO1 • Explain the working of different semiconductor devices.

CO2 • Measure and calculate various parameters of different semiconductor devices.

CO3 • Conclude VI characteristics of various semiconductor devices.

CO4 • Explain the working of different type of amplifier and design a specific operating frequency of an oscillator.

CO5 • Compare SCR, DIAC, TRIAC and IGBT

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	-	-	-	-	-	-	*	*
CO2	3	3	-	2	-	-	-	*	*
CO3	3	2	-	3	-	-	-	*	*
CO4	3	3	3	-	-	-	-	*	*
CO5	3	1	-	-	-	-	-	*	*

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 EXPERIMENTS

Ex. No.	Name of Experiment	Periods
1.	Construct the circuit and plot the VI characteristics of the PN Junction Diode , find the cut in voltage	4
2.	Plot the V-I Characteristic of Zener Diode.	4
3.	Plot the V-I Characteristic of Photo Diode.	4
4.	Plot the V-I Characteristic of Light emitting Diode.	4
5.	Simulate half wave, full wave and bridge rectifier using simulation tool like P Spice/ Orcad/ Multisim.	4
6.	Construct a Half Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results.	4
7.	Construct a Full Wave Rectifier and obtain regulation characteristics – Without Filters and with Filters Compare the results.	4
8.	Plot input and output characteristics of transistor in CB /CE/CC configuration.	4
9.	Build and test voltage divider biased type amplifier & measure voltage at different points on the circuit and observe waveforms.	4
10.	Obtain the characteristics of DIAC and TRIAC 3	4

11.	Obtain frequency response of Single stage RC/RL -coupled amplifier.	4
12.	Develop a simulation model for Voltage Series and Voltage Shunt Feedback Amplifiers	3
13.	Develop circuits for Voltage Series and Voltage Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	3
14.	Develop a simulation model for Current Series and Current Shunt Feedback Amplifiers	3
15.	Develop circuits for Current Series and Current Shunt Feedback Amplifiers and obtain output plots. Compare the results with the simulation model.	3

5. INSTRUCTIONAL STRATEGY

Electronic Components & Devices being a fundamental subject, it needs to be handled very carefully and in a manner such that students develop clear understanding of the related concepts and principles. The teacher may lay more emphasis on laboratory work and give home assignments to students to inculcate self-study and problem-solving abilities amongst them.

3.6	DIGITAL ELECTRONICS (Practical)	L T P 0 0 4

1. COURSE OBJECTIVES

The objective of a Digital Electronics Practical Course is to provide hands-on experience in understanding and implementing fundamental concepts of digital electronics. The course aims to familiarize students with the design, analysis, and troubleshooting of digital circuits, including logic gates, flip-flops, multiplexers, and counters. It emphasizes the practical application of Boolean algebra, binary arithmetic, and digital systems through laboratory experiments. Students will gain skills in using digital measuring instruments, designing circuits, and testing their functionality.

2. COURSE OUTCOMES(CO):

The practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

Students will be able to

CO1 • Understand the fundamentals of logic gate implementation.

CO2 • Create a digital circuit for the provided boolean expression.

CO3 • Construct basic combinational circuits and verify their functionalities.

CO4 • Design basic sequential circuits.

CO5 • Store/retrieve data from memory

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	3	2	3	-	-	-	-	-
CO2	3	3	3	3	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-
CO5	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. LIST OF EXPERIMENTS

Ex. No.	Name of Experiment	Periods
1.	Verification of Demorgan's Theorems.	4
2.	To verify the truth tables for all logic Gates– NOT,OR,AND,NAND,NOR, X-OR, X-NOR Gates.	4
3.	Realization of Logic Gates using universal Gates.	3
4.	Design and verification of the truth tables of Half and Full Adder circuits.	3
5.	Design and verification of the truth tables of Half and Full Subtrator circuits.	3
6.	Design and verification of the truth tables of 4 to 1 Multiplexer (74150) and 1 to 4 De-Multiplexer (74154) circuits.	4
7.	To convert a given octal input to the binary output and to study the LED display using 7447 7-segment decoder.	4
8.	Construct and test the performance of parity generator.	3
9.	Design and test of an S-R flip-flop using NOR/NAND gates.	4
10.	Design and test of an J-K flip-flop using NOR/NAND gates.	4
11.	Design and test of an T flip-flop using NOR/NAND gates.	4
12.	Construct and test the performance of Decade counter.	4
13.	Design a Programmable Up-Down Counter with a 7 Segment Display.	4
14.	Design of 4-bit shift register.	4
15.	To conduct an experiment to store a set of data in a RAM using IC 2114 starting from location ……..to location …… and retrieve the same data.	4

5. INSTRUCTIONAL STRATEGY

Digital Electronics Practical course focuses on a hands-on, experiential learning approach. It integrates theoretical concepts with practical experiments to reinforce

understanding. Initially, students are introduced to basic digital components and circuits through demonstrations. Following this, they engage in guided experiments, designing and testing circuits such as logic gates, flip-flops, and counters. Interactive discussions, problem-solving sessions, and troubleshooting exercises encourage critical thinking. To enhance learning, students use simulation software and real-time equipment, ensuring proficiency in digital tools.

3.7(a)	PRODUCT DESIGN & DEVELOPMENT (Theory)	L T P 2 0 0

1. COURSE OBJECTIVES

This course is designed to provide the basic concepts of Product Design and Development (PDD), understanding of various phases of PDD, hands on CAD on various tools used for PDD, Manufacturing Considerations, Detail Design and Engineering, 3D CAD design tool with its different features and applications, concept creation and 3D modelling, part design, generative shape design, assembly design, etc., prototyping of concept models using Additive Manufacturing. This course helps students to convert Ideas into real products.

2. COURSE OUTCOMES(CO):

The subject 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.

Students will be able to

CO1 • Comply with Industry health and safety guidelines

CO2 • Familiarize with the product design process to design a new product

CO3 • Use CAD software to design a component with solid part model, sheet metal part model and assembly models

CO4 • Develop concept models, Detail Design, Engineering Drawing, GD&T

CO5 • Create 3D printing part using slicing software and 3D CAD modelling

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	-	-
CO2	3	2	3	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-

CO4	3	-	3	-	-	-	-	-	-
CO5	3	-	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- INDUSTRIAL SAFETY PRACTICES (04 Periods)

(i) Types and use of fire extinguishers.
(ii) Safe handling and maintenance of tools and equipment.
(iii) Importance of using proper tools.
(iv) Occupational safety and health (OSH) practices.

UNIT 2- INTRODUCTION TO PRODUCT DESIGN DEVELOPMENT (06 Periods)

(i) Introduction and need for product design.
(ii) Stages of the PDD process and standard industry practices.
(iii) Key elements: market research, customer needs, feasibility, concept design, ergonomics, regulatory aspects, and cost.
(iv) Detailed design: material selection, Design for Assembly (DFA), Design for Manufacturing (DFM) and Design failure mode and effect analysis (DFMEA)
(v) Verification, validation, quality control, packaging.
(vi) Program management and product support.

UNIT 3- ENGINEERING DRAWING & 3D DESIGN TOOLS (06 Periods)

(i) Basics of engineering drawings, projections, and views.
(ii) Concept creation, 2D/3D design, and use of design tools.
(iii) Introduction to 3D CAD software and its applications.
(iv) Overview of modules: part, surface, assembly, drawing.
(v) Interface, customization, specification tree, and layout.

UNIT 4- CONCEPT CREATION & 3D MODELLING (06 Periods)

(i) Sketcher tools and dimensional constraints.
(ii) Part design (Pad, Pocket, Hole, etc.).
(iii) Surface design (Extrude, Sweep, etc.).
(iv) Assembly design, constraints, exploded views, BOM.
(v) Engineering drawings and GD&T.
(vi) Case studies on modelling different materials.

UNIT 5- ADDITIVE MANUFACTURING (06 Periods)

(i) Basics of prototyping and 3D printing.
(ii) Material types and selection based on properties and applications.
(iii) 3D printing process and industrial uses.
(iv) Introduction to slicing software and its functions

5. INSTRUCTIONAL STRATEGY

To effectively deliver the above content, begin with interactive lectures and multimedia presentations to introduce core concepts, supported by real-world case studies. Incorporate demonstrations and guided tutorials, especially for CAD tools, engineering drawing, and additive manufacturing. Encourage collaborative group work and design projects to foster creativity and problem-solving in product development. Practical sessions should follow each theory component, allowing learners to immediately apply their knowledge through lab-based exercises and simulations. Finally, integrate industry guest talks or virtual factory visits to expose students to current practices and trends, making the learning process more engaging and career-relevant.

6. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	4	12
2	6	22
3	6	22
4	6	22
5	6	22
Total	28	100

3.7 (b)	FUNDAMENTALS OF INNOVATION AND DESIGN THINKING (Theory)	L T P 2 0 0

1. COURSE OBJECTIVES

This course is designed to give a strong understanding of basic concepts of Innovation & Design thinking, to develop many creative ideas through structured brainstorming sessions. The ideas are validated through 3D printing& confirmatory tests. Design thinking is an iterative process that use to understand users & usage patterns, their assumptions, redefine problems and create innovative solutions. It is most useful to tackle problems that are ill-defined or unknown.

2. COURSE OUTCOMES(CO):

The subject 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.

Students will be able to

CO1 • Comply with Industry health and safety guidelines

CO2 • Create value by using problems solving approach and by applying innovation techniques

CO3 • Create innovative products, processes, services, business models etc.

CO4 • Familiarise with 3D CAD modelling software, common Engineering standards, symbols

CO5 • Start their own business | start up | entrepreneurship

3. SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO	PS

No.	Basic and Discipline Specific Knowledge	Problem Analysis	Design/ Development of Solutions	Engineering Tools	Practices for Society, Sustainability and Environment	Project Management	Life Long Learning	1	O2
CO1	3	-	-	-	2	-	1	-	-
CO2	3	3	-	1	-	-	-	-	-
CO3	3	-	2	1	-	-	-	-	-
CO4	3	2	1	2	-	-	-	-	-
CO5	3	-	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- INDUSTRIAL SAFETY PRACTICES (04 Periods)

(i) Types and use of fire extinguishers.
(ii) Safe handling and maintenance of tools and equipment.
(iii) Importance of using proper tools.
(iv) Occupational safety and health (OSH) practices.

UNIT 2- INTRODUCTION TO INNOVATION & DESIGN THINKING (06 Periods)

(i) Definition, types, and necessity of innovation.
(ii) Linear vs non-linear innovation; open vs closed models.
(iii) Design thinking: principles, mindset, and value.
(iv) Risk-reward analysis in innovation.
(v) From innovation to start-up: key steps.
(vi) Scoping and foundational principles of design thinking.

UNIT 3- DESIGN THINKING TOOLS & IDEA GENERATION (06 Periods)

(i) Brainstorming techniques and tools.
(ii) Phases of design thinking: Explore, Empathize, Experiment, Engage, Evolve.
(iii) Tools: SCOPES, STEEP, POEMS, SCAMPER.
(iv) Deep user needs analysis (SPICE).
(v) Idea selection, concept development, prototyping.

(vi) Storytelling, co-creation, strategic alignment.
(vii) Case studies.

UNIT 4- INTRODUCTION TO 3D MODELING & ADDITIVE MANUFACTURING
(06 Periods)

(i) CAD tools, 3D modeling, product drawing & BOM.
(ii) Prototyping basics and its industrial role.
(iii) Additive vs traditional manufacturing.
(iv) Types of 3D printers, components, working, software (slicing).
(v) Laser cutting basics, process, applications, pros & cons.
(vi) Case studies and latest advancements.

UNIT 5- START-UP & PROJECTION PLAN (06 Periods)

(i) Basics of management, leadership, HR, communication, and production.
(ii) Entrepreneurial concepts and forms of business.
(iii) Start-up essentials: planning, research, vision, model, operations.
(iv) Business modeling, market positioning, financial analysis.
(v) Start-up success factors and common failure points.
(vi) Case studies and project work.

5. INSTRUCTIONAL STRATEGY

The teacher should lay stress on Demonstrations & Role Play, Video-Based Learning, **Case Study Analysis:** Discuss successful innovations to highlight theory in practice. He should assign real-world problems for learners to solve using design thinking, organize **Software Tutorials** and Business Plan Workshops.

6. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	4	12
2	6	22
3	6	22
4	6	22
5	6	22
Total	28	100

4.1	MICROPROCESSOR AND ITS APPLICATIONS (Theory)	L T P 3 0 0

1. COURSE OBJECTIVES

The course aims to cover the fundamental concepts and evolution of microprocessors, focusing on the 8085 and 8086 architectures, instruction sets, and programming. It includes peripheral interfacing, memory organization, and the development of assembly language skills, along with exploring real-world applications of microprocessor-based systems.

2. COURSE OUTCOMES(CO):

The theory should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

Students will be able to

CO1 • Explain the architecture, operation, and instruction set of microprocessors.

CO2 • Develop assembly language programs for microprocessors.

CO3 • Interface microprocessors with memory and peripheral devices.

CO4 • Design and implement microprocessor-based systems for real-world applications.

CO5 • Compare microprocessors and microcontrollers and understand their role in 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	PSO1	PSO2
CO1	3	2	1	1	-	-	3	*	*
CO2	3	3	2	2	-	-	2	*	*
CO3	3	2	3	3	2	2	2	*	*
CO4	3	3	3	3	2	3	3	*	*
CO5	2	2	2	3	2	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 MICROPROCESSOR (10 periods)

Evolution and History of microprocessors, Introduction to 8-bit, 16-bit, and 32-bit processors,
Architecture and Operation of the 8085 microprocessor, Addressing modes and Bus organization
Architecture and Operation of the 8086 microprocessor, Addressing modes and Bus organization

UNIT 2- 8086 MICROPROCESSOR PROGRAMMING (12 periods)

Instruction set of 8086 microprocessors, Assembly language programming, Stack, Subroutines and Interrupt Handling

UNIT 3- INTERFACING WITH PERIPHERAL DEVICES (8 periods)

Memory and I/O interfacing,8255 Programmable Peripheral Interface, DC, DAC, and sensor interfacing, Serial and parallel communication

UNIT 4- MICROPROCESSOR-BASED SYSTEM DESIGN (6 periods)

Design of microprocessor-based control systems, Industrial applications of microprocessors, Data acquisition and process control, Case studies of real-world applications

UNIT 5- MICROCONTROLLERS AND EMBEDDED SYSTEMS (6 periods)

Introduction to Microcontrollers (8051), Difference between microprocessors and microcontrollers, Role of microcontrollers in embedded systems, Applications of modern microprocessor-based systems

5. TEXT BOOKS/ REFERENCE BOOKS:

1. Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, PHI.
2. Douglas V. Hall, Microprocessors and Interfacing: Programming & Hardware, McGraw-Hill.
3. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning.

5. A.P. Godse & D.A. Godse, *Microprocessor and its Applications*, Technical Publications.
6. Muhammad Ali Mazidi, *The 8051 Microcontroller and Embedded Systems*, Pearson.

6. INSTRUCTIONAL STRATEGY

The approach involves explaining concepts with real-world examples, hands-on microprocessor programming, and developing microprocessor-based systems. It also encourages self-study and case study discussions to enhance problem-solving skills.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	10	24
2	12	29
3	8	19
4	6	14
5	6	14
Total	42	100

4.2	PRINCIPLES OF ELECTRONIC COMMUNICATION (Theory)	L T P 3 0 0

1. COURSE OBJECTIVES

The rapid advancements in communication engineering necessitates a thorough understanding of its fundamental principles. This course aims to equip students with comprehensive knowledge of filters, modulation-demodulation, audio-video systems and antenna which will prepare students to analyse, troubleshoot and adapt to the advancements in the field of communication technologies.

2. COURSE OUTCOMES(CO):

The theory should be taught in such a manner that students can acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

CO1 • To understand the fundamentals of communication systems.

CO2 • Analyse the performance of communication channels, including bandwidth, noise, and signal distortion effects.

CO3 • To design a basic communication system.

CO4 • To select appropriate modulation techniques for specific applications.

CO5 • understand the fundamentals of antenna.

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	-	-	-	-	-	-	*	*
CO2	3	-	-	2	-	-	-	*	*
CO3	3	-	-	-	-	-	-	*	*
CO4	3	-	-	3	-	-	-	*	*
CO5	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 COMMUNICATION ENGINEERING (04 Periods)

Introduction to electromagnetic frequency spectrum- relationship between wavelength and frequency

Filters: Definition, types of filters and their frequency response characteristics- LPF, HPF and BPF - applications

Noise: Definition, Types of noise and their sources, SNR and noise figure

Distortion - Definition, types of distortion, Difference between noise and distortion

Concept of fidelity, selectivity and sensitivity

Introduction to modulation- Need of modulation, Concept of frequency translation

UNIT 2- AMPLITUDE MODULATION (11 Periods)

Definition of amplitude modulation, Expression for AM and its waveform representation, frequency spectrum and bandwidth of AM wave, relative power distribution in carrier and side bands.

Elementary idea of DSB, DSB-SC SSB and VSB modulation

Principles of AM modulators: Square Law Modulator, Balanced Modulator

Principles of AM Demodulator: Diode Detector Circuit

Need and Principles of Super Heterodyne Receiver

UNIT 3- ANGLE MODULATION (11 Periods)

Frequency Modulation: Concept of Angle Modulation, Definition of FM modulation, Waveform representation of FM, Expression for FM and its frequency spectrum, modulation index, maximum frequency deviation and deviation ratio, bandwidth a FM signals, Carzon's rule, Pre-emphasis and De-emphasis, FM modulator and demodulator circuit in brief

Phase Modulation: Definition, expression for PM and its frequency spectrum, modulation index, PM modulator and demodulator circuit in brief, comparison of FM, PM and AM communication systems

UNIT 4 - DIGITAL MODULATION TECHNIQUES (10 Periods)

Digital Modulation Techniques- ASK, FSK, PSK, BPSK modulation and demodulation techniques (only block diagram, operation and waveforms)- Basic concept of OFDM

Pulse modulation techniques: Generation and detection of PAM PWM and PPM

Pulse Digital modulation techniques: PCM and DM transmitter and receiver

UNIT 5 - INTRODUCTION TO ANTENNAS (06 Periods)

Definition of Antenna, Importance and applications of Antenna, Basic parameters: radiation pattern, gain, directivity, impedance, polarization

5. TEXT BOOKS/ REFERENCE BOOKS

1. Principles of communication systems by Taub Schilling, T.M.H.
2. Fundamentals of communication systems by Proakis & Salehi, Pearson education
3. Communication Systems by Simon Haykin, John Wiley
4. Communication Systems (Analog and Digital) By R.P. Singh, S.D. Sapre, T.M.H.
5. Modern Digital & Analog Communication by B.P. Lathi, Oxford Publications
6. Digital & Analog Communication Systems by K.S. Shanmugam, John Wiley
7. E-books/e-tools to be used as recommended by AICTE/NITTTR, Chandigarh.

6. INSTRUCTIONAL STRATEGY

An effective strategy will involve a blend of theory and hands-on practice. Start with foundational concepts like signal processing and modulation techniques, followed by practical experiments and simulations. Encourage problem-solving, group discussions, and case studies to reinforce understanding and foster critical thinking.

7. SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	4	10
2	11	26
3	11	26
4	10	24
5	6	14
Total	42	100

4.3	ELECTRONIC INSTRUMENTATION and MEASUREMENT	L T P 2 0 2

1. COURSE OBJECTIVES

Instrumentation is an emerging field used in data detection, acquisition, analysis and control in industrial applications. Analog and digital instruments are mainly used to determine different process parameters. These instruments present the desired information in visual indication either in analog or digital form. The course builds on students' knowledge of basic measuring tools, covering the principles, concepts, and techniques of analog and digital electronic measurement methods for accurate process parameter determination.

2. COURSE OUTCOMES

The theory should be taught should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

Students will be able to

CO1 • Measure various electrical parameters with accuracy, precision, resolution.

CO2 • Measure relevant parameters using AC and DC bridges.

CO3 • Make use of electronic instruments for lifelong measurements.

CO4 • Make use of front panel controls of DSO/CRO for appropriate measurements.

CO5 • Select appropriate passive or active transducers for measurement of physical phenomenon.

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	-	3	-	-	-	*	*
CO2	3	2	-	3	-	-	-	*	*
CO3	3	2	-	3	-	-	2	*	*
CO4	3	-	-	3	-	-	-	*	*
CO5	3	3	-	3	1	-	1	*	*

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 MEASUREMENTS (04 Periods)

Measurement, Method of measurements, Types of instruments, Accuracy & Precision, Sensitivity, Resolution, Types of Errors, Sources of errors, Loading effect

UNIT 2- AC AND DC AND BRIDGES (04 Periods)

DC Bridges –Wheatstone and Kelvin Double Bridge (Only comparative study)
AC Bridges - Maxwell's Bridge, Hay's Bridge, Anderson Bridge, De-Sauty's Bridge (Only comparative study)

Ex. No.	Name of Experiment	Periods
1.	Determine the value of unknown resistance using Wheatstone bridge.	2
2.	Measure Low resistance by Kelvin's Double Bridge.	2
3.	Measure unknown inductance using following bridges (a) Anderson's Bridge (b) Maxwell's Bridge.	2

UNIT 3- MEASURING INSTRUMENTS (07 Periods)

Permanent Magnet Moving Coil Instruments (PMMC), Moving Iron Type Instruments (MI), Electro Dynamo Type Instruments, Single Phase Energy Meter, Applications of DC Potentiometer and AC Potentiometers, Various types of Electronic Instruments.

Ex. No.	Name of Experiment	Periods
4.	List various standard sources & measuring **UNIT**s. Measure DC & AC voltages, current using ammeter and voltmeter.	2
5.	Test diodes and transistors using analog and digital Multimeter.	2
6.	Study the working of Q-meter and measure Q of coils.	2

UNIT 4- OSCILLOSCOPES (07 Periods)

Cathode ray tube: probe structure (1:1,10:1), construction, operation, screens, Graticules vertical deflection system, Horizontal deflection system, Delay line, Measurement of frequency, time delay, phase angle and modulation index (trapezoidal method), Oscilloscope probe: Structure of 1:1 and 10:1probe, Multiple Trace CRO, Digital storage oscilloscope (DSO).

Ex. No.	Name of Experiment	Periods
7.	Operate front panel controls of DSO/CRO to observe various waveforms.	2
8.	Measure time, voltage, frequency, phase difference of input signals using DSO/CRO.	2
9.	Demonstrate features of digital storage oscilloscope.	2
10.	Experiment with front panel controls of various signal generators and observe output Waveform.	2

UNIT 5- Transducers (06 Periods)

Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of following Transducers: RTD, Thermocouple, Thermistor, LVDT, Strain Gauge Load Cell, Piezoelectric Transducers.

Ex. No.	Name of Experiment	Periods
11.	Measure strain/stress using strain gauge measurement.	2
12.	Measure displacement using LVDT.	2
13.	Measure temperature using thermistor and thermocouple.	2
14.	Using a piezo resistive sensor to measure pressure variations/Using a piezoelectric sensor to measure sound vibrations.	2

5. TEXT BOOKS/ REFERENCE BOOKS

1. Electrical & Electronic Measurement & Instruments A.K. Sawhney, Dhanpat Rai & Sons, India
2. Electronic Instrument and Measurement Technique W.D. Cooper Prentice Hall International, India.
3. Electronic Measurement & Instrumentation J.G. Joshi Khanna Publishing House, Delhi
4. Measurement systems application and design E.O. Doebelin and D. N. Manik, Tata Mcgraw-Hill
5. Electronic Measurements and Instrumentation Oliver and Cage, Tata Mcgraw-Hill
6. Basic Electrical Measurement M.B. Stout Prentice hall of India, India
7. Electronic Instrumentation H. S. Kalsi ,Tata Mcgraw-Hill

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	4	15
2	4	15
3	7	25
4	7	25
5	6	20
Total	28	100

4.4	PROGRAMMING IN C (Practicum)	L T P 1 0 4

1. COURSE OBJECTIVES

Computers play a vital role in present day life, more so, in the professional life of technician engineers. People working in the field of computer industry, use computers in solving problems more easily and effectively. In order to enable the students, use the computers effectively in problem solving, this course offers the modern programming language C along with exposition to various applications of computers. The knowledge of C language will be reinforced by the practical exercises. This course introduces to the students the Python language. Upon completion of this course, the student will be able to write non trivial Python programs dealing with a wide variety of subject matter domains. Topics include language components, the IDLE/IDE environment, control flow constructs, strings, I/O, collections, classes, modules, and regular expressions.

2. COURSE OUTCOMES

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

CO1 • Develop the concepts C programming language and identify a problem and formulate an algorithm for it.
CO2 • Model various control structures and implement them
CO3 • Identify various types of variables.
CO4 • Make use of pointer in an array and structure.
CO5 • Interpret the concepts of Python programming language

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	3	2	1	-	-	-	-
CO2	3	1	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-
C	3	1	-	-	-	-	-	-	-

O 4									
C O 5	3	1	2	2	1	-	-	-	-

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 (0 4 Periods)

Brief idea of low level and high level programming languages, steps in development of a Program, Flow charts, Algorithm development, Programme Debugging, Introduction to Python, Basis of C programming, I/O statements, Assign statements, Constants, variables and data types, Operators and Expressions, Standards and Formatted IOS, Data Type Casting

Ex. No.	Name of Experiment	Periods
1	Programming exercises on executing and editing a C program.	4
2	Programming exercises on defining variables and assigning values to variables.	2

UNIT 2- CONTROL STRUCTURES (02Periods)

Decision making with IF – statement, IF – Else and Nested IF, While and do-while, FOR loop Break. Continue go to and switch statements

Ex. No.	Name of Experiment	Periods
3	Programming exercises on arithmetic and relational operators.	2
4	Programming exercises on arithmetic expressions and their evaluation	4
5	Programming exercises on formatting input/output using printf and scanf and their return type values.	4

UNIT 3- FUNCTIONS (04Periods)

Introduction to functions, Global and Local Variables, Function Declaration, Standard functions Parameters and Parameter Passing, Call - by value/reference, Recursion

Ex. No.	Name of Experiment	Periods

6	Programming exercises using if statement.	2
7	Programming exercises using if – Else.	4
8	Programming exercises on switch statement	4
9	Programming exercises on do – while, statement	4

UNIT 4- ARRAYS **(02Periods)**

Introduction to Arrays, Array Declaration, Length of array, Single and Multidimensional Array, Arrays of characters, Passing an array to function, Pointers to an array

Ex. No.	Name of Experiment	Periods
10	Programming exercises on for – statement.	3
11	Programs on one-dimensional array.	3
12	Programs on two-dimensional array.	4
13	(i) Programs for putting two strings together. (ii) Programs for comparing two strings.	2

UNIT 5- POINTERS **(02Periods)**

Introduction to Pointers, Address operator and pointers, Declaring and Initializing pointers Single pointer, Introduction to Colab, Programming in Python.

Ex. No.	Name of Experiment	Periods
14	Simple programs using structures	2
15	Simple programs using pointers.	2
16	Simple programs using union.	2
17	Practice basic coding syntax in Python language	4

5. TEXT BOOKS/REFERENCE BOOKS

1. Let Us C, Yashavant Kanetkar
2. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House

3. C Programming Absolute Beginner's Guide, Dean Miller and Greg Perry
4. Learning Python by Mark Lutz; Pratham Books, Bangalore
5. Foundations of Python Network Programming by John Goerzen and Brandeu Rhodes; A press-e Book distributed by Springer Science and Business Media, New York

6. INSTRUCTIONAL STRATEGY

The digital systems in microprocessors have significant importance in the area of electronics. Adequate competency needs to be developed by giving sufficient practical knowledge in microprocessors (programming as well as interfacing), A/D, D/A Converters and other topics. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject. Programming exercises other than the tested in circulation may be given to the students.

4.5	MICROPROCESSOR AND ITS APPLICATIONS (Practical)	L T P 0 0 6

1. COURSE OBJECTIVES

The course aims to familiarize students with microprocessor hardware and software, provide hands-on experience in assembly language programming, and develop skills in interfacing microprocessors with peripheral devices. It focuses on microprocessor-based system design and enhances analytical, design, and implementation skills through laboratory experiments

2. COURSE OUTCOMES(CO):

CO1 • Write and execute basic assembly language programs using 8085/8086.
CO2 • Develop programs involving arithmetic, logical, and control instructions.
CO3 • Interface microprocessors with input/output devices.
CO4 • Design and simulate microprocessor-based solutions to simple problems.
CO5 • Document and analyse practical experiments effectively

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	3	-	-	2	*	*
CO2	3	3	2	3	-	-	2	*	*
CO3	3	3	3	3	2	-	2	*	*
C	3	3	3	3	2	2	3	*	*

O4									
CO5	2	2	2	2	-	2	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. LIST OF EXPERIMENTS

Ex. No.	Name of Experiment	Hours
1.	Introduction to 8085/8086 kit and instruction set	3
2.	Add two 8-bit numbers using 8085	3
3.	Subtract and compare two 8-bit numbers	3
4.	Multiply two 8-bit numbers using repeated addition	3
5.	Divide two 8-bit numbers using 8085	3
6.	Block data transfer using 8085	3
7.	Sorting of an array using 8085	3
8.	To add two hexadecimal & decimal numbers using 8085.	3
9.	To subtract two hexadecimal & decimal numbers using 8085.	3
10.	Interfacing ADC/DAC with 8085	3
11.	To interface ADC & DAC with 8085 & demonstrate generation of square wave.	3
12.	Add two 8-bit numbers using 8086	3
13.	Subtract and compare two 8-bit numbers using 8086	3
14.	Multiply two 8-bit numbers using repeated addition using 8086	3
15.	Divide two 8-bit numbers using 8086	3
16.	Block data transfer using 8086	3
17.	Sorting of an array using 8086	3

18.	Perform various logical operation using 8086	3
19.	Perform universal gate operation using 8086	3
20.	Find 1s' and 2's complement of a number in 8086	3
21.	Program for LED blinking using microprocessor I/O interfacing	3
22.	Stepper motor interfacing using 8255	3
23.	Traffic light control simulation using 8085	3
	REVISION	15

5. INSTRUCTIONAL STRATEGY

Begin with fundamental concepts and progressively advance to more complex ideas. Collaborative problem-solving is encouraged through pair or group learning. Real-time experiments reinforce theory, and documentation and discussion of outcomes are emphasized to deepen understanding and reflection.

4.6	**PRINCIPLES OF ELECTRONIC COMMUNICATION (Practical)**	**L T P**
		0 0 6

1. COURSE OBJECTIVES

This laboratory provides foundational knowledge in communication systems through experiments that cover both theoretical and practical aspects. Students use industry-standard instruments like oscilloscopes and spectrum analysers, alongside simulations with advanced software tools. These exercises offer hands-on experience with core components of modern communication technologies, bridging real-world and simulated environments.

2. COURSE OUTCOMES(CO):

CO1 • Understand the basic principles of communication systems, including analog and digital communication.

CO2 • Apply concepts such as modulation and demodulation in communication systems.

CO3 • Develop practical skills by operating electronic instruments like oscilloscopes, spectrum analysers, and signal generators.

CO4 • Simulate communication systems to model real-world scenarios and analyse simulation results to evaluate the performance and efficiency of communication systems.

CO5 • Measure and analyse key antenna parameters

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	-	-	-	-	*	*
CO2	3	2	2	-	-	-	-	*	*
CO3	3	2	2	-	-	1	2	*	*
CO4	3	2	2	2	-	1	2	*	*
CO5	3	2	2	-	-	1	-	*	*

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 EXPERIMENTS

Ex. No.	Name of Experiment	Periods
1.	Construct and test the performance of LPF,HPF and BPF	3
2.	Construct and test the performance of AM Modulator	3
3.	Construct and test the performance of AM demodulation using envelope detector.	3
4.	(a) To obtain an AM wave from a square law modulator circuit and observe waveforms (b) To measure the modulation index of the obtained wave form. Observe under modulated, 100% modulated & over modulated AM	6

5.	Construct and test the performance of FM Modulator	3
6.	Construct and test the performance of FM demodulator	3
7.	To obtain an FM wave and measure the frequency deviation and modulation index for different modulating signals.	3
8.	Test the performance of ASK modulator and demodulator and draw its input and output waveform	3
9.	Test the performance of PSK modulator and demodulator and draw its input and output waveform	3
10.	Test the performance of FSK modulator and demodulator and draw its input and output waveform	3
11.	Construct and test the performance of Sample and Hold Circuit.	3
12.	To observe the sampled signal and compare it with the analog input signal. Note the effect of varying the sampling pulse width and frequency on the sampled output.	3
13.	To observe and note the pulse amplitude modulated signal (PAM) and compare them with the corresponding analog input signal.	3
14.	To observe PPM signal and compare it with the analog input signal	3
15.	To observe PWM signal and compare it with the analog input signal	3
16.	Construct and test the performance of Pulse Width Modulator	3
17.	Determine the directional characteristics of Moving Coil Microphone	3
18.	Determine the directional characteristics of Dynamic core Loudspeaker.	3
19.	Test the performance (its field strength, radiation pattern, bandwidth, efficiency, polarization, and gain) of a given dipole antenna. Plot the radiation pattern for different length of antennas.	6
20.	Test the performance of given Yagi-Uda antenna	3
Simulation Experiments Any 10 experiments should be performed through open source simulation tools		
Ex. No.	**Name of Experiment**	**Periods**

1. 1	Simulation of frequency response of LPF.	
2. 2	Simulation of frequency response of HPF.	
3. 3	Simulation of frequency response of BPF.	
4. 4	Simulation of DSB modulation and demodulation.	
5.	Simulation of DSB-SC modulation and demodulation.	
6.	Simulation of SSB modulation and demodulation.	
7. 5	Simulation of FM modulation and demodulation.	
8. 6	Simulation of PM modulation and demodulation.	18 periods
9.	Simulation of ASK modulation and demodulation.	
10.	Simulation of PSK modulation and demodulation.	
11.	Simulation of BPSK modulation and demodulation.	
12.	Simulation of FSK modulation and demodulation.	
13. S	Simulate the sampling of an analog signal.	
14. 7	Simulation of PAM generation.	
15. 8	Simulation of PWM generation.	
16. 9	Simulation of PPM generation.	
17.	Simulation of Delta Modulation.	
18.	To simulate and analyse the performance of different types of dipole antenna and understand their key parameters such as radiation patterns, gain, directivity, and bandwidth.	

19.	To simulate and analyse the performance of different types of Yagi-Uda antenna and understand their key parameters such as radiation patterns, gain, directivity, and bandwidth.	
20.	To design a basic communication system.	

5. INSTRUCTIONAL STRATEGY

Emphasize on hands-on learning through laboratory experiments and simulation tools. Students gain practical experience using instruments like oscilloscopes, spectrum analyzers, and signal generators to test modulation techniques and analyze system performance. Simulation software (MATLAB, P-SPICE) aids in modelling communication systems and analyzing signal behaviour in different conditions. The strategy integrates real-world case studies to link theory with practice, ensuring students understand the application of communication systems in modern technology. Continuous feedback through assessments and project evaluations supports skill development and concept mastery.

4.7 (a)	**ELECTRIC VEHICLE(Theory)**	**L T P**
		2 0 0

1. COURSE OBJECTIVES

This course aims to provide a solid foundation in electric vehicle (EV) technology, government policies, and their economic and environmental implications. It explores the different systems and subsystems within electric vehicles and their respective functions. Students will gain insight into the calculations involved in EV design and operation, as well as guidelines for selecting critical components, such as motors, motor controllers, battery packs, battery management systems, charging infrastructure, and regenerative braking. The course also covers essential regulatory standards, safety protocols, electrical wiring harness design, and testing norms for electric vehicles, along with the latest advancements in EV technology.

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• Comprehend and adhere to industry health and safety guidelines while working with electric vehicles to mitigate hazards.

CO2• Identify key components of electric vehicles and their functions and apply basic calculations related to EV design and operation.

CO3• Troubleshoot EV component faults

CO4• Apply effective techniques for troubleshooting, repairing, and maintaining electric vehicle systems to minimize potential hazards.

CO5• Design and assemble components for basic electric vehicle 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	PSO1	PSO2
CO1	3	-	-	-	-	-	-	*	*
CO2	3	2	1	-	-	-	-	*	*
CO3	3	2	-	-	-	-	-	*	*
CO4	3	2	2	-	-	-	-	*	*
CO5	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 INDUSTRIAL SAFETY PRACTICES & ELECTRIC VEHICLE (04 Periods)

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

Overview electric Vehicle Technologies, India policy regarding electric vehicles, Electric vehicle advantages and limitations, Electric vehicle effects on the economy and environment

UNIT 2- ELECTRIC VEHICLE ARCHITECTURE, MOTORS AND CONTROLLERS (06 Periods)

Types of Electric Vehicles (Overview of electric vehicle technologies like BEV, HEV, PHEV and FCEV.), Basic architecture of electric vehicle drivetrains, Overview of various system and subsystem of Electrical Vehicle and their functions.

Function and operation of electric vehicle motors, Classification of electrical vehicle motors, Types of loads acing on vehicle, Motor specifications, Motor calculation for electric vehicle, Motor selection, Motor controllers and its function, Motor controller selection, Function and operation of a DC-to-DC converter, Basic Wiring harness for EV, Overview of regenerative braking, function & working

UNIT 3- ENERGY STORAGE SYSTEM & CHARGING SYSTEM, ELECTRIC VEHICLE BATTERY MANAGEMENT SYSTEM AND BASIC REGULATORY REQUIREMENTS (08 Periods)

Electric Vehicle Energy Storage & Charging System, Overview of battery pack. (Cell selection, battery connection, battery pack construction), Overview of battery pack sizing, Thermal management, charging system types, Fundamentals of constant voltage and constant current charging, Standards for electric car charging, Connector standards for charging electric vehicles, Calculation for battery recharging and discharge, Pros and Limitations of batteries for electric vehicles, Regenerative Braking Systems.

Introduction to Battery Management System, function of a battery management system (BMS), Block diagram of the battery management system, Thermal control system, cell load distribution, and State of Charge (SOC) and State of Health (SOH) analysis, Difference between high voltage and low voltage system, Maintenance & repairing of electric vehicle system, Basic Regulatory Requirements.

UNIT 4- ELECTRIC VEHICLE CIRCUIT PROTECTION SAFETY, REPAIR AND MAINTENANCE OF EV (06 Periods)

Introduction to electrical wiring harness, Importance of colour coding and labelling on wiring harness, Materials used for wiring harness and its selection criteria, Design consideration in wiring harness, Understand wire gauge and power rating capacity, Types of Electric vehicle

Fuses, Electric Vehicle Relays, Selection of relay type, Positioning Fuses and relays in Electric vehicle circuit.

Preventive maintenance of EV, Standard procedure to work on high voltage systems, Diagnosis and fault finding, Schedule servicing of EV, Predictive maintenance of EV.

UNIT 5- ELECTRIC VEHICLE TESTING AND TECHNOLOGY ADVANCEMENT IN ELECTRIC VEHICLE (04 Periods)

Vehicle Performance testing for acceleration, top speed, range, braking, hill climbing, vehicle structure, road handling, weather resistance, etc., Vehicle Durability testing or life expectancy of parts, materials, and components, Safety: battery safety, charging system safety, and occupant safety, Emission standard and its testing, Vehicle Noise standards and its testing, Advancements in electrical vehicle: Autonomous Driving, Battery Technology to improved range, greater efficiency, and faster charging, life span of batteries, Charging Infrastructure (public charging networks, on-the-go charge, development in vehicle overnight charging technology, wireless Charging).

* Case studies and Mini Project should be carried out throughout the semester.

5. TEXT BOOKS/REFERNCE BOOKS

1. **Electric Vehicle Technology Explained**
   Authors: James Larminie, John Lowry
   Publisher: Wiley
2. **Modern Electric Vehicle Technology**
   Author: C.C. Chan, K.T. Chau
   Publisher: Oxford University Press
3. **Electric and Hybrid Vehicles: Design Fundamentals**
   Author: Iqbal Husain
   Publisher: CRC Press
4. **Electric and Hybrid Vehicles: Technologies, Modeling and Control – A Mechatronic Approach**
   Author: Amir Khajepour, M. Saber Fallah, Avesta Goodarzi
   Publisher: Wiley
5. **Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives**
   Author: Chris Mi, M. Abul Masrur, David Wenzhong Gao
   Publisher: Wiley
6. **Battery Management Systems for Large Lithium Ion Battery Packs**
   Author: Davide Andrea
   Publisher: Artech House
7. **Electric Vehicles: Prospects and Challenges**

Editors: Tariq Muneer, Irene Illescas García
Publisher: Elsevier

8. **Power Electronics for Electric Vehicles and Energy Storage**
   Author: Anup Bhattacharya
   Publisher: Springer
9. **Automotive Power train and Electric Vehicle Systems**
   Author: Alexander G. Arnold
   Publisher: SAE International
10. **The Electric Car: Development and Future of Battery, Hybrid and Fuel-Cell Cars**
   Author: Michael Here ward Westbrook
   Publisher: IET (Institution of Engineering and Technology)

6. INSTRUCTIONAL STRATEGY

Use a blended instructional strategy combining lectures, multimedia, hands-on activities, and case studies to teach electric vehicle concepts. Incorporate project-based learning, real-world demonstrations, and expert talks to deepen understanding. Assess through quizzes, presentations, and practical projects, encouraging exploration of EV technology, environmental impact, and industry trends.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	4	15
2	6	20
3	8	30
4	6	20
5	4	15
Total	28	100

4.7 (b)	INDUSTRIAL ROBOTICS (Theory)	L T P
		2 0

		0

1. COURSE OBJECTIVES

This course aims to equip students with foundational and advanced knowledge of industrial robotics, including robot anatomy, programming, kinematics, and control systems. Students will learn to design, simulate, and operate robotic systems used in manufacturing. Emphasis is placed on automation integration, safety protocols, and real-world applications, preparing learners for careers in robotics engineering, industrial automation, and smart manufacturing environments.

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• Comprehend and adhere to industry health and safety guidelines while working with robots' vehicles to mitigate hazards.

CO2• Differentiate coordinate systems and define the custom or user-defined coordinate frames.

CO3• Develop simple robot programs that incorporate various types of movements along with their respective parameters.

CO4• Integrate robot with different automation components i.e., PLC HMI, conveyor etc.

CO5• Create variety of innovative ideas and develop creative approaches to problem-solving.

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	-	-	-	-	-	-	*	*
CO2	3	2	-	-	-	-	-	*	*
CO3	3	-	2	1	-	-	-	*	*
CO4	3	-	1	-	-	-	-	*	*
CO5	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.

4. CONTENT

UNIT 1- INTRODUCTION TO INDUSTRIAL SAFETY PRACTICES AND INTRODUCTION TO INDUSTRIAL ROBOTICS (08 Periods)

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

Introduction of Robots and their Importance in Manufacturing and Production, Applications of robots in manufacturing and assembly for which they can be efficiently utilized, Role of robots and automation systems in boosting the safety at dangerous manufacturing tasks, Structure and functions of robot System (Basic Package) and additional Equipment, Major Applications of Robots-Pick and Place, Arc Welding, Ultrasonic welding, Part Transfer, Packing, Palletizing. Type of End of arm tools and differences between them: Handling tools - Pneumatic Gripper, Vacuum Gripper, Hydraulic Gripper, Hydraulic Gripper, and Servo-Electric Gripper. Welding guns – Arc Welding guns, Spot welding guns. Robotic cell and its various components. Cycle time and its importance. Operator job in robotic cell. Safety procedure for Programmer and an Operator.

UNIT 2- JOGGING OF ROBOT (04 Periods)

Turn ON /OFF Steps of Robot, Checking Robotic cell Health, Introduction to Teach pendent and key functions, Industrial robot Coordinate system, Different coordinate systems in Robots, Defining X, Y, Z co-ordinate system, Jogging Robot using Teach pendant in different Modes of coordinate systems: Joint co-ordinate system, rectangular co-ordinate system, and User or object co-ordinate system, Tool co-ordinate system, TCP (Tool centre point definition) i.e., TCP File. , Creating user defined work objects i.e., user coordinate frame File. (Box, circle, triangle work object definition)

UNIT 3- PROGRAMMING OF A OF ROBOT USING TEACH PENDANT (06 Periods)

Robot Program Structure, Different Motion Types used in Programming (PTP, Linear, Circular, Spline): Move J (PTP) , Move L (Linear) , Move C (Circular) , Move S (Spline) ; Different Motion Parameters used in Program Point Recording, Basic Program creation using Motion types and parameters, Path optimization for smooth robot movement and cycle time, Safety instructions to be followed while loading and unloading of parts.

UNIT 4- ROBOT INTEGRATION WITH PLC, HMI AND OTHER EQUIPMENT (06 Periods)

PLC and robot communication and HMI, Conveyor system and its communication with PLC, Methods to create fencing and safety equipment's, Steps to work with two different types of

Robots at same project, Tool mounting on Robot Flange, Different connections of grippers (Electric, Pneumatic etc.).

UNIT 5- ROBOT PROGRAMMING WITH ADVANCE LEVEL INSTRUCTIONS

(04 Periods)

Loop control instructions, Arithmetic and Logical instructions, Shift instructions, Interfacing End of arm tools to Robot using robot I/O, establishing communication between Robot I/O and PLC modules, Function Keys in Pendant for Arc welding and Material Handling robot, MIG welding Instructions in Robot, MIG welding Program and how to optimize it, Material Handling Program and how to optimize it.

* Case studies and Mini Project should be carried out throughout the semester.

5. TEXT BOOKS/REFERNCE BOOKS

1. **Modern Robotics: Mechanics, Planning, and Control**
   Authors: Kevin M. Lynch, Frank C. Park
   Publisher: Cambridge University Press
2. **Robot Modelling and Control**
   Authors: Mark W. Spong, Francesco Bullo
   Publisher: Wiley
3. **Springer Handbook of Robotics**
   Editors: Bruno Siciliano, Oussama Khatib
   Publisher: Springer
4. **Robotics for Engineers**
   Author: Yoram Koren
   Publisher: McGraw-Hill
5. **Robotic Engineering: An Integrated Approach**
   Author: Richard D. Klafter, Thomas A. Chmielewski, Michael Negin
   Publisher: Prentice Hall

6. INSTRUCTIONAL STRATEGY

Combine theoretical instruction with hands-on training using robotic arms and simulation software. Use lectures, demonstrations, and lab sessions to teach robot programming, kinematics, and control. Incorporate project-based learning, real-world case studies, and industry visits. Assess through practical tasks, quizzes, and group projects to reinforce industrial robotics applications.

7.SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	8	30
2	4	15
3	6	20
4	6	20
5	4	15
Total	28	100

4.8	ESSENCE OF INDIAN KNOWLEDGE AND TRADITION	L T P 2 0 0

COURSE OBJECTIVE:

Understand the fundamental aspects of the Indian Knowledge System, its integration with modern science, principles of Yoga and holistic healthcare, and practical applications in contemporary contexts.

LEARNING OUTCOMES:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

- Overview, importance, and relevance of the Indian Knowledge System, including Vedas, Upavedas, Vedangas, and Upangas.
- Relevance of science and spirituality, and contributions of ancient Indian science and technology.
- Basic principles of Yoga, benefits of holistic healthcare, and integration with modern healthcare.
- Practical applications and case studies of the Indian Knowledge System's relevance today.

COURSE CONTENTS

UNIT 1: Introduction to Indian Knowledge System (16 Periods)

Overview of Indian Knowledge System

- Importance and relevance
  - Introduction to the Vedas
  - Upavedas
  - Vedangas
  - Upangas

UNIT 2: Modern Science and Indian Knowledge System (06 Periods)

- Relevance of Science and Spirituality,
- Science and Technology in Ancient India,

UNIT 3: Yoga and Holistic Healthcare (04 Periods)

- Basic principles of Yoga
- Benefits of holistic healthcare practices
- Integration with modern healthcare

UNIT 4: Case Studies / Assignment (02 Periods)

- Practical Applications / Case studies demonstrating the relevance of Indian Knowledge System in modern times

Assessment

Viva -Voce Exam

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	1hr	3hrs	3hrs
Exam Marks	20	20	20	60	60
Converted to	10	10	15	15	60
Tentative Schedule	5th Week	10th Week	Regularly	12th -13th 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.

SUGGESTED DISTRIBUTION OF MARKS

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

2. EVALUATION METHOD for 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**	**Practical Test and Quiz – Viva Voce**	**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 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 (Practical External)

	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 PRACTICUM (Theory External)

	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 Pre Semester Examination**	**Practical Documentation and Micro Project**	**End Semester Examination**
Portion	2 units	50% Practical	2 units	50% Practical	All units	All Practical	All units
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	5th Week		10th Week		Regularly	12th -13th 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

3.5 : EDC & 3.3 : LIC , 3.4 ECN

Sr. No.	Equipment	Qty Required	Approximate Cost (in Rs) Per unit
1	DSO/Oscilloscope (50 Mhz, 2 channel)	6	30000
2	Function Generator (0-1 MHz)	6	25000
3	Dual Power Supply (+/- 30V)	6	20000
4	Ammeter (0-20 mA)	10	2000
5	Ammeter (0-200 µA)	10	2500
6	Voltmeter	10	1000
7	Bread Board	20	300
8	Transformer (6V-0-6V)	20	500
9	Decade Capacitor Box	10	500
10	Decade Resistor Box	10	500
11	PN Diode IN4007	50	10
12	Zener Diode	50	10
13	Transistor BC 107	50	52
14	FET BFW11	50	45
15	N channel FET (BFW11)	50	40
16	IC 741	50	20
17	IC555	50	20
18	IC566	50	28
19	IC723	50	50
20	IC7805	50	20
21	Probes and Connecting Wire	100	50

3.6 Digital Electronics

Sr. No.	Equipment	Specification	Qty	Approximate Cost (in Rs)
1.	DC regulated multiple output power supply	• 2 output channel • DC output(Multiple output): DC 0 to 30V/2A, DC 0 to +/-15V /1A Tracking, 4.5 to 5.5 /5A • Setting resolution: V 10 mV, I 5mA • Load Regulation : ≤ ± (0.05% +10 mV) • Line Regulation: ≤ ± (0.05% +10 mV) • Ripple and noise: ≤ 1 mVrms • Internal Resistance: ≤ 10 mΩ • Stability: ≤ 2.5 mV at full load • Recovery Time: ≤ 50 ms • Display: Switchable 3 digit seven segment LED for Voltage & Current • Display Accuracy: V : ± (1% + 1	**06**	**12000**

		digit), I : ± (1% + 3 digit) • Protection: Built-in overheat, over voltage protections. • Input Supply: 230 AC ± 10% /50-60 Hz		
2.	**Digital storage Oscilloscope with probe**	• Bandwidth: 100 MHz maximum bandwidth. • No. Of channels: 2 • Maximum memory depth. 1 Mpts • Maximum sample rate: 1 GSa/s • ADC Bits: 8 bits • Waveform math: Add, subtract, multiply, divide, FFT (magnitude and phase), low pass filter • Display: : ≤ 6.5-inch TFT LCD WVGA • Real Time Sample Rate- 1 GSa/s (each channel), 500 MSa /s(Dual Channel), Equivalent Sample rate- 25 GSa/S, Digital filter and waveform Recorder, function- math functions, digital filter, waveform recorder, cursor measurenment-mannual, track and auto measure modes • Connectivity: USB 2.0 (host and device) with waveform analysis software. • External tigger:1 • Avilable trigger type: 6 Standard (Edge, Pulse, Video, Rise/Fall, Setup/Hold, Pattern/State) • Edge trigger slope: Rising, Falling, Rising + Falling • Available Measurements: 22. • Calculated rise time: ≤ 3.5 ns • Time base range: 5 ns/div to 50 s/div 4 cable RG58 C/U 50Ω.	**40000**	**06**
3.	Electronic Digital Multimeter	• TRMS • Auto / Manual Ranging • 19999 Count • LCD with Backlight • Auto Power Off • Capacitance • Frequency • Duty Cycle	**4000**	

		• Data Hold • MIN / MAX • Diode Test • Audible Continuity • DC Voltage. 19.999mv-1000 volt, Accuracy ±(0.5% rdg + 3 dgt) • AC Voltage. 19.999mv-750 volt, Accuracy ±(0.5% rdg + 3 dgt) • AC Response 40Hz ~ 1KHz • DC Current : 199.99 / 1999.9µA / 19.999 / 199.99mA / 1.9999 /10.000A • Accuracy: ± (0.8% rdg + 3 dgt) on 199.99 / 1999.9 µA ± (1.0% rdg + 3dg) • AC current TRMS: : 199.99 / 1999.9µA / 19.999 / 199.99mA /1.9999 / 10.000A • Accuracy ± (0.8% rdg + 3 dgt) on 199.99 / 1999.9 µA ± (1.0% rdg + 3dg) • Resistance: 199.99Ωto 199.99MΩ • Accuracy ± (1% rdg + 3 dgt at 199.99Ω)		
4.	Function Generator	• **Waveforms:** Sine, Square, Ramp, Triangle, Pulse, Noise, DC, Dual tone. • 25 MHz Sine and 10MHz Square waveforms. • Sample rate: 125MSa/s • 8Mpt length Arbitrary Waveform Generator • Channels: 2 • Advanced Waveforms PRBS, RS232, Sequence • Built in Arbitrary Waveforms 160 types of waveforms, including Sinc, Exponential Rise, Exponential Fall, ECG, Gauss, Haver Sine, Lorentz, etc. • Resolution 5 µHz • High frequency stability: ±1 ppm; low phase noise: -105 dBc/Hz; • Built-in high-order harmonic generator (at most 8-order harmonics)	**25000**	

		• Accuracy ±(1 ppm of the setting value + 10 pHz) • Noise (-3 dB): 100 MHz bandwidth • Ramp Frequency range: 1 uHz to 500 kHz, • Pulse Frequency range: 1 uHz to 10 MHz Pulse width • **Amplitude:** Range 1mVpp to 10 Vpp into 50 Ω, Accuracy (at 1 kHz): ± 2% of setting ± 1 mVpp **UNIT**s: Vpp, Vrms, dBm, Resolution: 0.1mVpp or 4 digits. DC offset Range: (peak AC + DC) ± 5 V into 50 Ω • **Trigger Characteristics:** Trigger Input: Level TTL-compatible, Slope Rising or falling (selectable) Pulse Width >100 ns Trigger output: Level TTL compatible, Output impedance 50 Ω, typical Maximum rate 1 MHz • **Modulation feature:** AM, FM, PM, ASK, FSK ,and PWM modulation types Carrier waveform: Sine, Square, Ramp, Arb Modulating Waveform: Sine, Square, Ramp, Noise, Arb • **Operations:** Linear & logarithmic sweeps and burst operation • **Connect:** via USB, GPIB • **Display:** ≤ 4 inch colour touch screen		
5.	Logic probes (TTL and CMOS)	Testing of TTL and CMOS, displaying logic states and pulse presence, catching pulse of 10 ns or pulse train to 50 MHz, input over voltage protection	**1400**	
6.	Digital logic trainer (TTL)	General purpose IC Trainer KIT to accommodate 20 pin ICs and 40 pin IC and all available ICs in ZIF socket (All the Pins of ZIF socket should be available to be connected by patch chords on board switchable Digital inputs and output LEDs on board.- OUTPUT D.C. VOLTAGE : Fixed 5V and 0 - ±18V.	**6000**	

		OUTPUT CURRENT: 1 Amp. LOAD REGULATION : ± 1% of the highest specified output voltage. (NO LOAD TO FULL LOAD) RIPPLE AND NOISE : less than 2 mV LOGIC INPUTS : Minimum 16 switches for High/Low 07. OUTPUT INDICATORS : 16, 5 mm bright Red LEDs. SEVEN SEGMENT DISPLAY : 4 digit seven segment display with decoder driver. DIGITAL VOLTMETER: Digital DC voltameter range 0 - 20V. BREAD BOARD : Unique solder - less large size, spring loaded breadboard INPUT VOLTAGE : 230V ±10% at 50 Hz A.C. Mains.		
7.	**Miscellaneous loose items.**	• **Different values resistances**. Quarter Watt (1/4) Resistances (Carbon Film):(1K, 1.5K, 2K, 2.2K, 4.7K, 5K,6K, 7K, 8K, 10K, 20K, 50K,100K. and other ranges available.)-100 each; Half Watt (1/2) Resistances(Carbon Film): (1K, 1.5K, 2K, 2.2K, 4.7K, 5K,6K, 7K, 8K, 10K, 20K, 47K,100K and Other Ranges Available)-100 each; 5-Watt Resistances:(1 Ohm(<10%), 2 Ohm (<10%), 5 Ohm(<5%), 10 Ohm, 50 Ohm,100Ohm, 1K, 2.2K, 4.7K, 10K,20K 47K.)-100 each **Bread-board.** • 20 **UNIT** High Quality breadboard • Breadboard Dimension: ≤ 5. cm x 16 cm x 1cm • Points: ≤800 points **Connecting leads (single stand wire).** • 200 meter Single core conductor wire for breadboard with 22-24 American wire gauge (AWG) or		

		0.20-0.25mm^2 cross section with isolation. **DSO probe.** • Total: 10 **UNIT** • Coaxial cable • Characteristic impedance: 50-52Ω • Series: RG58 C/U cable **Single stand Wire cutter**. • Total: 02 **UNIT**. Single stand wire cutter for cutting the wire **Different color and voltage level LEDs Red, Blue, green, yellow)**		
8.	**ICs**	QUAD 2-INPUT NAND GATE 7400 QUAD 2-INPUT NOR GATE 7402 HEX INVERTER 7404 QUAD 2-INPUT AND GATE 7408 DUAL 4-INPUT NAND SCHMITT TRIGGER 7413 QUAD 2-INPUT OR GATE 7432 EXPENDABLE DUAL 2-WIDE 2-INPUT AOI GATE 7450 DUAL 4-INPUT EXPANDER 7460 EDGE - TRIGGERED FLIP-FLOP 7470 DUAL JK M/S FLIP-FLOP 4027 DUAL JK-FLIP-FLOP 7473 4 BIT FULL ADDER 7483 QUAD 2-INPUT EXCLUSIVE OR-GATE 7486 DECADE COUNTER 7490 . DIVIDE-BY-TWELVE COUNTER 7492 4-BIT BINARY RIPPLE COUNTER 7493 4-BIT SHIFT REGISTER 7495 QUAD 3-STATE BUFFER 74126 8-INPUT MULTIPLEXER 74151 1-OF-16 DECODER/DEMULTIPLEXER 74154 8-BIT D/A CONVERTER DAC 0808 8-BIT A/D CONVERTER ADC 0808 4 bit synchronous counter 74161 BCD to seven segment display 7447 Priority Encoder 3:8 74148 3:8 Decoder 74138		

9.	Advance Digital Trainer Kit	4bit Adder, 4bit subs tractor, Flip-flops, SISO SIPO PIPO PISO shift registers	**18000**	
10.	Analog and digital ic tester	• Test variety of TTL and CMOS ICs up to 16 pins. • 16x2 Character LCD display • 9V/12V Power Adapter Two Keys for simple operation No training required, automatic operation 20 Pin ZIF socket provided for testing. Built-in self-diagnostic ICs	**38000**	

4.3 ELECTRONIC INSRUMENTATION AND MEASUREMENT (PRACTICUM)

Sr. No.	**Equipment**	**Specifications**	**Qty Required**	**Approx. Cost per UNIT**
1	Digital Multimeter	Auto / Manual Ranging, LCD with Backlight, Auto Power Off, Capacitance, Frequency, Duty Cycle, Data Hold, MIN / MAX, Diode Test, Audible Continuity, DC Voltage.	4	4000
2	Analog Multimete	Standard DC voltage range settings include 0.5 V, 2.5V, 10V, 50V, 250V, and 1000V. Standard AC voltage settings are 10V, 50V, 250V, and 1000V.with standard DC settings of 2.5, 25, and 250 amperes.	4	1000
3	Maxwell'S Inductance Bridge	Frequency: 1KHz +-3%, amplitude 0-15Vpp.Power: +-5V+-12V & +5V/ 500mA.	2	4500
4	Anderson's Bridge Trainer kit	Frequency: 50Hz,Input Signal: 1Khz , 0-20Vp-p,Null Detector: Digital, Operating Supply Voltage: 220VAC,Power Source: Electricity	2	4500
5	WheatStone Bridge Trainer Kit	Power Supply: 12V DC , Phase: single phase, Interface: NO, Automation Grade: Manual, Capacity: 50Hz, Channels: Dial Box	2	1200
6	Kelvins Double Bridge Trainer	On board oscillator section, On board amplifier section, On board unknown Resistors for conducting the experiment, Block Description Screen printed on glassy epoxy PCB	2	8050
7	LCR-Q METER	Variables Measured: L, C, R & Q.	2	LS

		Measurement Modes : Series or parallel equivalent. Measurement: User selectable 100Hz or 1KHz. Frequency Accuracy of : ±0.25%. Measurement Maximum Voltage : 0.285V rms (0.8V p-p) (approx.)		
8	DSO	Bandwidth: 100 MHz maximum bandwidth. No. Of channels: 2,Maximum memory depth. 1 Mpts, Maximum sample rate: 1 GSa/s, ADC Bits: 8 bits, Waveform math: Add, subtract, multiply, divide, FFT (magnitude and phase), low pass filter, Display: : ≤ 6.5-inch TFT LCD WVGA	2	40000
9	Function Generator	Waveform- sine,Frequency-0 - 15MHz, Type-Digital	2	14000
10	Single Phase Linear Variable Differential Transformer	Power (VA)- DC 24 and RMS 3,Phase-Single Phase, Input Voltage-24 DC, Output Voltage-4-20 MA, Cooling Type-Dry Type/Air Cooled, Oil Cooled.	1	35000
11	Transducers: Pressure type, thermocouple, LVDT, opto Pick-up, electromagnetic pick-up, ultrasonic pick-up and potentiometer etc		LS	30000
12	Thyristor control experimental kits Instrumentation/Transducer experimental kit. Basic electronic experiment kit		LS	250000

4.4 Programming in C

Sr.No.	Equipment	Specifications	Qty.	Price (Approx)
1.	Computer Desktop	I7 8th Generation, 1TB HDD,8GB RAM, Preloaded Windows with 5 years Warranty	30	240000
2.	Online UPS	6VA with Battery	02	200000
3.	Switch	24 Port 10/100/1000 (Manageable)	01	50000
4.	Connectors	RJ-45, RJ-11,BNC,SC,ST	LS	10000
5.	Cables	UTP,STP,OFC 25m each	LS	10000
6.	MFP		01	30000
7.	Router		01	40000
8.	Computer Server	Quad core, Intel processor, 32Gb RAM		500000

9.	Modem with Router		01	10000
10.	Hardware kit	For computer assembling and disassembling	08	150000
11.	External HDD	-	04	30000
12.	Internet Connectivity	-	30 Nodes	150000
13.	Computer system demonstration kit	-	01	
14.	Printer Demonstration Kit	-	01	100000
15.	SMPS Demonstration Kit	-	01	20000
16.	Unmanaged Switch	-	04	60000
17.	Hub	-	02	20000
18.	Air conditioner	2 Tones	02	70000
19.	Miscellaneous	Cables, Connectors, Computer Stationary, Toner Cartridge, Ink Cartridge	LS	30000
20.	Python IDE(py charm/ Eclipse with Py Dev/VS code etc.	Freeware	-	-
21.	Ms Office Latest or equivalent FOSS	Office (Freeware		Per year
22.	Compile Turbo C, C++ or equivalent FOSS	-	01	10000
23.	Web Camera, Mike, Speaker	LS	LS	20000

4.5 MICROPROCESSOR AND ITS APPLICATIONS

S. No.	Equipment	Specification	Quantity	Price(Approx.)
1.	Computer with UPS	Intel I5 processor capable to support "C" programming and required Microcontroller Simulator softwares MPLAB X IDE etc.. .	15	40000 (each)
2.	PIC 18 Development kit	PIC 18 Development kit, With inbuilt power supply, keyboard, LCD displays, ports for interfacing	6	10000 (each)

		peripheral and memory.		
3.	Microcontroller based interfacing study cards	Microcontroller based interfacing study cards, Capable to interface LCD, Keyboard, ADC, DAC, Sensor, Relay, DC motor, Stepper Motor With PIC 18 Development kit.	6	10000
4.	Miscellaneous Items	20 Stepper motor 50/100RPM , ADC/DAC(0808) trainer board, LCD trainer board, Relay Trainer board, Keyboard 4*4 trainer board, 20Temperature sensor(Mq series), 20 LDR (I2C light sensor),20 Potentiometer,20 LM35 IC etc.		20000

4.6 PRINCIPLES OF ELECTRONICS COMMUNICATION

Sl. No.	Equipment	Specifications	Quantity	Price (approx. for each UNIT)
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	2	40000
2	MATLAB Software	Student Version	2	LS
3	Kit - AM Modulation & Demodulation	Audio Signal Source Type : Sinusoidal Frequency range : 200 Hz to 3.5 KHz Amplitude : 0 – 5 V variable Carrier Source : 1 MHz DC Source/Level Shifter : 0 – 5 V variable Balance Modulator : DSB - AM Transistorized Modulator : DSB - AM Envelope Detector : With adjustable band filter	2	20000
4	Kit - FM Modulation and Demodulation	Audio Signal Source Type Frequency range Amplitude : : : Sinusoidal 0- 3.4 KHz 0 – 5 V variable DC Source/Level Shifter : 0 – 5 V variable Frequency	2	20000

		Modulation : Using VCO Frequency Demodulation : Using PLL		
5	Kit - PAM-PPM-PWM Modulation-Demodulation Techniques	Pulse Modulation Techniques Pulse Amplitude Modulation Pulse Width Modulation Pulse Position Modulation On-board Sampling : 8 KHz, 16 KHz, Frequencies (Pulse) : 32 KHz, 64 KHz On-board Generator Sinewave Squarewave Low Pass Filter : 1 KHz & 2 KHz (Gain adjustable) : 1KHz & 2 KHz th : 4 order BW filter	2	10000
6	Function Generator		3	
7	DSO	Analog Bandwidth (-3 dB) : 70MHz-100MHz, No. of Analog Channels : 2 + EXT, Sampling Mode : Real-time Sampling , including various probes	4	55000