NEP-2020 Aligned Curriculum for

Three Year (Six Semesters) Diploma Programme in

ELECTRICAL AND ELECTRONICS ENGINEERING

(3rd to 4th Semester)

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Semester System

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Prepared By:

Institute Of Research Development & Training, U.P., Kanpur

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THIRD SEMESTER

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PREFACE

An important issue generally debated amongst the planners and educators world over 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 opens 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. The initiatives being taken by the State Board of Technical Education, UP to revise the existing curricula of 42 diploma programmes as per the needs of the industry and making them NEP-2020/AICTE compliant, are laudable.

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 programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the 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.

Director

Institute of Research Development & Training

ACKNOWLEDGEMENTS

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1. Sh. Narendra Bhooshan, IAS, Additional Chief Secretary, Department of Technical Education, Govt. of UP, for his exemplary vision & approach.

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

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6. 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

Shyam Lal
Textbook Officer/Course Coordinator
IRDT Kanpur

1. SALIENT FEATURES

1)	Name of the Programme	:	Diploma in Electrical and Electronics Engineering
2)	Duration of the Programme	:	Three years (Six Semesters)
3)	Entry Qualification	:	Matriculation or equivalent NSQF Level as Prescribed by State Board of Technical Education, UP
4)	Pattern of the Programme	:	Semester Pattern
5)	NSQF Level	:	Level - 5
6)	Ratio between theory and Practical	:	40: 60 (Approx.)

7) **Industrial Training**

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

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

8) **Ecology and Environment**

As per Govt. of India directives a subject on Environmental Science has been incorporated in the curriculum.

9) **Entrepreneurship and Start-ups**

A full subject Entrepreneurship & Start-ups has been incorporated in the curriculum.

10) **Student Centred Activities**

A provision of 4-8 hrs per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS, library and other cultural activities.

11) **Project work**

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

2- PROGRAM OUTCOMES (POs)

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

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.

3. 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.

4. LEARNING OUTCOMES OF THE PROGRAM

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.
12.	Understand basic principles of digital electronics and design combinationaland sequential circuits.
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 levellanguage 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
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.
26	Apply acquired knowledge and skill in solving a live problem or Industrial project
27	Use modern communication system

5- ABSTRACT OF CURRICULUM AREAS

HUMANITIES & SOCIAL SCIENCES COURSES [HS]

- Communication Skills in English
- Sports and Yoga
- Entrepreneurship and Start-ups

BASIC SCIENCES COURSE [BS]

- Mathematics
- Applied Physics
- Applied Chemistry

ENGINEERING SCIENCE COURSES [ES]

- Engineering Graphics
- Engineering Workshop Practice
- Introduction to IT Systems
- Fundamentals of Electrical & Electronics Engineering
- Engineering Mechanics

PROGRAM CORE COURSES [PC]

- Digital Electronics
- Electric Machine- 1
- Electrical Circuit
- Electronics Workshop
- Electric Power Generation, Transmission And Distribution
- Electric Machine- II
- Programming In C

PROGRAM ELECTIVE COURSES [PE]

Program Elective -1

- ELECTRONIC INSTRUMENTATION AND MEASUREMENT OR
- FUNDAMENTAL OF COMMUNICATION ENGINEERING

Program Elective-2

- MICROPROCESSOR AND ITS APPLICATIONS OR
- RENEWABLE ENERGY POWER PLANTS

OPEN ELECTIVE COURSES [OE]

Open Elective -1

- DISASTER MANAGEMENT OR
- ENERGY EFFICIENCY AND AUDIT

Open Elective-2

- PROJECT MANAGEMENT OR
- ECONOMIC POLICIES IN INDIA OR
- ELECTRIC VEHICLE (TATA)
- INDUSTRIAL ROBOTICS (TATA)

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

- Summer Internship – I (3-4 weeks) after IInd Sem
- Summer Internship – II (4-6 weeks) after IVth Sem
- Major Project(In-House) / Internship / Industrial Training

AUDIT COURSES [AU]

- Environmental Science
- Essence of Indian Knowledge and Tradition
- Indian Constitution

6-STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMM IN ELECTRICAL & ELECTRONICS ENGINEERING

NOTE: I & II Sem. is common to all Engineering & Technology branches and implemented from the session 2024-2025

THIRD SEMESTER (ELECTRICAL & ELECTRONICS ENGINEERING)

Sr. No.	SUBJECTS	COURSE TYPE & CATEGORY	STUDYSCHEME 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	Digital Electronics	Program Core (Theory)	03	-	-	3	40	-	40	60	3	-	-	60	100
3.2	Electric Machine- 1	Program Core (Theory)	04	-	-	4	40	-	40	60	3	-	-	60	100
3.3	Electrical Circuit	Program Core (Practicum)	01	-	04	3	-	60	60		-	40	3	40	100
3.4	Electronics Workshop	Program Core (Practicum)	01	-	04	3	-	60	60	-	-	40	3	40	100
3.5	Digital Electronics (Lab)	Program Core (Practical)	-	-	04	2	-	60	60	-	-	40	3	40	100
3.6	Electric Machine- 1 (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*	-	-	-	-	-	-	-	-
	Advance Skill Development	OPEN Elective (Certification Course)	-	-	-		-	-	-	-	-	-	-	-	-
3.8	Summer Internship** (4 Weeks)	-	-	-	-	2	-	50	50	-	-	-	-	-	50
#Student Centered Activities		-	-	-	09	-	-	50	50	-	-	-	-	-	50
Total			**11**		**25**	**21**	**80**	**340**	**420**	**120**		**160**		**280**	**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 (ELECTRICAL & ELECTRONICS ENGINEERING)

Sr. No.	SUBJECTS	COURSE TYPE & CATEGORY	STUDYSCHEME Periods/Week			Credits	MARKSINEVALUATIONSCHEME								Total Marks of Internal & External
							INTERNALASSESSMENT			EXTERNALASSESSMENT					
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
4.1	Electric Power Generation, Transmission And Distribution	Program Core (Theory)	03	-	-	3	40	-	40	60	3	-	-	60	100
4.2	Electric Machine- II	Program Core (Theory)	03	-	-	3	40	-	40	60	3	-	-	60	100
4.3	Programming In C	Program Core (Practicum)	01	-	04	3	-	60	60	-	-	40	3	40	100
4.4	Program Elective -1	Program Core (Practicum)	02		02	3	40	-	40	60	3	-	-	60	100
4.5	Program Elective -2	Program Core (Theory)	03		-	3	40	-	40	60	3	-	-	60	100
4.6	Electric Machine- II (Lab)	Program Core (Practical)	-	-	04	2	-	60	60	-	-	40	3	40	100
4.7	(Q) Open Elective -2 **Or**	Open Elective (Theory)	02	-	-	2	50*	-	-	-	-	-	-	-	-
	Advance Skill Development	OPEN Elective (Certification Course)	-	-	-		-	-	-	-	-	-	-	-	-
4.8	(Q) Essence Of Indian Knowledge And Tradition	Audit Course	02	-	-	-	50*	-	-	-	-	-	-	-	-
#Student Centered Activities			-	-	10	-	-	50	50	-	-	-	-	-	50
Total			**16**		**20**	**19**	**160**	**170**	**330**	**240**	**-**	**80**	**-**	**320**	**650**

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

Note:SUMMER INTERNSHIP (4 -6 WEEKS) duration to be organised after fourth semester exam. Evaluation will be in fifth semester.

StudentCenteredActivitieswillcompriseofco-curricularactivitieslikeextensionlectures,games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C. NSS, library, Cultural Activities and self-study etc.

PROGRAME ELECTIVE-1

SR.NO.	SUBJECT NAME
(1)	ELECTRONIC INSTRUMENTATION AND MEASUREMENT
(2)	FUNDAMENTAL OF COMMUNICATION ENGINEERING

PROGRAME ELECTIVE-2

SR.NO.	SUBJECT NAME
1.	MICROPROCESSOR AND ITS APPLICATIONS
2.	RENEWABLE ENERGY POWER PLANTS

OPEN ELECTIVE-1

SR.NO.	SUBJECT NAME
1.	DISASTER MANAGEMENT or
2.	ENERGY EFFICIENCY AND AUDIT

OPEN ELECTIVE -2

SR.NO.	SUBJECT NAME
1.	ELECTRIC VEHICLE (TATA) or
2.	INDUSTRIAL ROBOTICS (TATA) or
3.	PROJECT MANAGEMENT or
4.	ECONOMIC POLICIES IN INDIA

OR.

OPEN ELECTIVE

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

THEORY	3.1 DIGITAL ELECTRONICS	L	T	P
		3	-	-

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.

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.

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	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.

COURSE CONTENTS

Unit I : 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 II : 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 III : **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 IV: **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 V : **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.

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

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.

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**

THEORY	3.2 ELECTRICAL MACHINES-I	L	T	P
		4	-	-

COURSE OBJECTIVES:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

•Maintain electric motors and transformers.

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.

CO1 : Understand the significance and operation of DC Generator.

CO2 : Understand the significance and operation of DC Motor.

CO3 : Describe Principles and applications of single-phase transformer.

CO4 : Describe the construction & operation of three-phase transformer and its accessories.

CO5 : Apply maintenance strategies for electrical equipment.

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	2	-	1	-	-	-	*	*
CO2	3	2	-	-	-	-	-	*	*
CO3	3	2	1	1	-	-	-	*	*
CO4	3	2	-	1	-	-	-	*	*
CO5	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.

COURSE CONTENTS

Unit I: DC Generators (10 Periods)

DC generator: construction, parts, materials and their functions.
Principle of operation of DC generator: Fleming's right-hand rule, schematic diagrams, e.m.f. equation of generator, armature reaction, commutation.
Applications of DC generators. Importance of DC generators in various industries

Unit II: D.C. Motors (10 Periods)

DC motor: Types of DC motors. Fleming's left-hand rule, Principle of operation of Back e.m.f.
and its significance, Voltage equation of DC motor.
Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency.
DC motor starters: Two Point, Three-point and Four Point starters.
Speed control of DC shunt and series motor: Flux and Armature control.
Brushless DC Motor: Construction and working.

Unit III: Single Phase Transformers (12 Periods)

Types of transformers: Shell type and core type;
Construction: Parts and functions,
Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage transformation ratio, Significance of transformer ratings
Transformer No-load and on-load phasor diagram, Leakage reactance,
Equivalent circuit of transformer: Equivalent resistance and reactance.
Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.
Polarity tests on single phase transformers.

Unit IV: Three Phase Transformers & Special Purpose transformers (12 Periods)

Three Phase Transformers: Construction, cooling, three-phase transformers connections, three-phase to two phase conversion (Scott Connection), parallel operation of three phase transformer.Comparison between Bank of three single phase transformers & Single unit of three phase transformer
Transformer accessories: Conservator, Breather, Explosion vent, Buchholz relay –ON load and OFF load tap changer.
Distribution and Power transformers. Auto Transformer and its applications

Unit V: Maintenance of DC Machines And Transformers (12 Periods)

Importance of Maintenance : Preventive and Breakdown Maintenance .
Causes of Sparking in Commutator , Defects in Commutator and Remedies ,Resurfacing of Commutator and Brushes , Defects in DC Armature winding
Maintenance of Transformer Oil , Transformer oil tester , Acidity test, BDV test
Earthing : Measurement of earth resistance.

INSTRUCTIONAL STRATEGY

Electrical motor and transformer being a core subject of electrical diploma curriculum, where a student will deal with various types of electrical motors and transformers which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these motors / transformer and give suggestions to improve their performance. Special care has to be taken on conceptual understanding of concepts and principles in the subject. For this purpose exposure to industry, work places, and utilization of various types of electrical motors and transformers for different applications may be emphasized. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid-term and end-term written tests

TEXT BOOKS/ REFERENCE BOOKS:

1. G.C. Garg & P.S. Bimbhra, Electrical Machines, Vol-I, II, Khanna Book Publishing House (ISBN: 978-9386173-447, 978-93-86173-607), New Delhi.
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education, New Delhi, ISBN: 9780070593572.
3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN:9780070699670
4. Dr. T.D.Bisht, Pooja Yadav , Ashish Sahoo Electrical Machine-I, Asian Publishers, Muzaffarnagar ISBN no. 978-93-91541-30-9
5. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN: 9789332902855.
6. Mehta, V. K. and Mehta, Rohit, Principles of Electrical Machines, S. Chand and Co. Ltd., New Delhi, ISBN: 9788121930888.
7. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S. Chand and Co. Ltd., New Delhi, ISBN: 9788121924375.
8. Bandyopadhyay, M. N., Electrical Machines Theory and Practice, PHI Learning Pvt. Ltd., New Delhi, ISBN: 9788120329973.
9. Murugesh Kumar, K., DC Machines and Transformers, ISBN: 9788125916055.

SUGGESTED DISTRIBUTION OF MARKS

Unit No.	Time Allotted (periods)	Marks Allotted (%)
I	10	20
II	10	20
III	12	23
IV	12	20
V	12	17
Total	**56**	**100**

PRACTICUM	3.3 ELECTRIC CIRCUIT	L	T	P
		1	-	4

COURSE OBJECTIVES:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
•Maintain electrical systems applying AC and DC circuit fundamentals.

COURSE OUTCOMES(CO):

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

CO1 : Analyse the parameters of single-phase AC series circuits.
CO2 : Analyse the parameters of single-phase AC parallel circuits.
CO3 : Analyse the parameters of poly phase AC circuits.
CO4 : Apply network reduction methods to solve DC circuits
CO5 : Apply network theorems to solve basic electrical circuits.

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO 1	PSO2
CO1	3	3	2	1	-	-	-	*	*
CO2	3	2	1	1	-	-	-	*	*
CO3	3	3	-	1	-	-	-	*	*
CO4	3	2	-	-	-	-	-	*	*
CO5	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.

COURSE CONTENTS

Unit I: Single Phase A.C Series Circuits
Sinusoidal quantities : Instantaneous, peak, average and effective values , Form Factor , Peak factor
R, L, C circuit elements its voltage and current response.
R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance triangle, active power, reactive power, apparent power, power triangle and phasor diagram, Power factor.
Resonance, Bandwidth, Quality factor and voltage magnification in series R-L, R-C, R-L-C circuit.

Practicals:

1. Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, C circuit.
2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.
3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.
4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.

Unit II: Single Phase A.C Parallel Circuits

R-L, R-C and R-L-C parallel combination of A.C. circuits. Impedance, reactance, phasor diagram, impedance triangle, active power, apparent power, reactive power, power triangle and phasor diagram, power factor.

Resonance Bandwidth, Quality factor and voltage magnification in parallel R-L, R-C, R-L-C circuit,

Practicals:

1. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L Parallel circuit. Draw phasor diagram.
2. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C Parallel circuit. Draw phasor diagram.
3. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C Parallel circuit. Draw phasor diagram.
4. Use variable frequency supply to create resonance in given series R-L-C Parallel or by using variable inductor or variable capacitor.

Unit III: Three Phase Circuits

Concept of generation of 3-phase alternating voltage, Advantage of 3-phase system over single-phase system, Phasor representation of three phase supply, Phase sequence and polarity.

Types of three-phase connections, Relation between phase and line quantities in three phase star and delta system.

Balanced and unbalanced load, three phase power, active, reactive and apparent power in star and delta system.

Practicals :

1. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for balanced three phase star connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
2. Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for balanced three phase delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.

Unit IV: Network Reduction and Principles of Circuit Analysis

Concept of voltage and current sources; symbol and graphical representation, characteristics of practical and ideal sources, Source transformation. Star/delta and delta/star transformation. Mesh Analysis. Nodal Analysis.

Practicals :

1. Use voltmeter, ammeter to determine current through the given branch of an electric network by applying nodal analysis.
2. Use voltmeter, ammeter to determine current through the given branch of an electric network by applying mesh analysis.

Unit V: Network Theorems

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Practicals:

1. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
2. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem
3. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem
4. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

TEXT BOOKS/ REFERENCE BOOKS:

1. Ashfaq Husain, Networks & Systems, Khanna Book Publishing, New Delhi.
2. Gupta, B. R; Singhal, Vandana; Fundamentals of Electrical Network, S. Chand and Co., New Delhi, ISBN: 978-81-219-2318-7
3. Saxena, S.B Lal; Dasgupta, K; Fundamentals of Electrical Engineering, Cambridge University Press Pvt. Ltd., New Delhi, ISBN: 978-11-0746-435-3
4. Theraja, B. L.: Theraja, A. K, A Text Book of Electrical Technology Vol-I, S. Chand & Co. Ramnagar, New Delhi, ISBN: 9788121924405
5. Sudhakar, A.; Shyammohan, S. Palli; Circuit and network, McGraw Hill Education, New Delhi, ISBN: 978-93-3921-960-4
6. Bell, David A., Electric Circuits, Oxford University Press New Delhi, ISBN: 978-01-954-25246
7. Boylested, R.L., Introductory circuit Analysis, Wheeler, New Delhi, ISBN: 978-00-231-3161-5
8. Mittle, V.N.; Mittle, Arvind; Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2
9. Sivanandam, S.N, Electric Circuit Analysis, Vikas Publishing House Pvt. Ltd, Noida, ISBN:978-81259-1364-1
10. Salivahanan, S.; Pravinkumar, S; Circuit theory, Vikas Publishing House Pvt. Ltd, Noida; ISBN:978-93259-7418-0

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with Maintain electrical systems applying AC and DC circuit fundamentals. R-L, R-C and R-L-C parallel combination of A.C. circuits. The inputs start with theoretical inputs to architecture, **Network Reduction and Principles of Circuit Analysis,** Star/delta and delta/star transformation small projects may identified, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Duality in electric circuits, with visits to industry.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva voce.

PRACTICUM	3.4 ELECTRONICS WORKSHOP	L	T	P
		1	-	4

COURSE OBJECTIVES:

To provide hands-on experience and practical skills in electronics, allowing students to build, test, and troubleshoot basic electronics and electrical circuits.

COURSE OUTCOMES (CO):

The theory and practical should be taught and performed, 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: Develop skill in selection and use of commonly used tools, equipment, components in a given situation.

CO2:Plan and Wire a small domestic building for a given load requirement.

CO3:Develop skill in wiring, soldering and desoldering works.

CO4:Develop skill in tracing circuits of simple (analog and digital) electronic assembly.

CO5: Prepare Printed Circuit boards

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

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

COURSE CONTENTS

Unit I: Electrical Workshop

Series and parallel connection of resistors, Introduction to different type of electrical materials (wires, cables, switches, fuses, coiling),Tools Used in Electrical Workshop and Safety Measures.

Practicals:

1. Identification and study of commonly used electrical materials such as wires, cables, switches, fuses, coiling, roses, battens, cleats and allied items.
2. Identification and study of various tools used in Electrical Workshop and safety measures.
3. Making connection of single lamp and three pin plug socket to supply using batten wiring.
4. Making Electrical connection for staircase wiring.
5. Making of extension board with proper supply.

Unit II: Electronics Workshop

Different types of power supplies, audio oscillator, function generator, signal generator, CRO, analog and digital multimeter, soldering, desoldering

Practicals:

1. Name and function of different tools and accessories including Tapes, Solders, Solders tips, Fluxes; De-soldering wick, Solder cleaning fluids, Sleeves, Tags.
2. Demonstrate the correct use of accessories mentioned above.
3. Find out the operating range and regulate the power supplies of
   a. Test waveform Generator
   b. Audio oscillator
   c. Function Generator
   d. Signal Generator
4. Measurement of waveform using:
   a. Single beam CRO
   b. Double beam/Dual trace CRO

5. Use of electronic and Digital multimeters, Transistor tester/Curve tracer, IC tester etc.
6. Study of Power Supply - UPS, Invertor, different types of DC/AC power supplies
7. Study of Various types of Single/Multicored, Insulated screened, Power type/ Audio/ Video/ General purpose wires and cables
8. Study of different processes by performing in assembling- Soldering, Desoldering, Cutting, Stripping and connecting.
9. Making of different types of mini projects

Unit III: Preparation of Printed Circuit Board

Introduction : Integrated circuits, PCB, Etching, Silk screen printing

Practicals :

Study of different types of PCB circuit in order to:

1.Acquire skill in silk screen printing techniques for the purpose of making the printed circuits boards.

2.Exposure to Non dry-method of PCB making using photoprocessing techniques.

3.Prepare, check, drill and store PCBs.

TEXT BOOKS/ REFERENCE BOOKS:

1. Practical electronics for inventors ; Paul scherz & Simon Monk
2. Getting Started in Electronics ; Charles Platt
3. Electrical engineering 101 ; Darren Ashby
4. Electronic Projects for Dummies ; Earl Boysen , Cathleen Shamieh
5. Sudhakar, A.; Shyammohan, S. Palli; Circuit and network, McGraw Hill Education, New Delhi, ISBN: 978-93-3921-960-4
6. PCB Design And Layout For DIY Etching ; A.B. Lawal's
7. Boylested, R.L., Introductory circuit Analysis, Wheeler, New Delhi, ISBN: 978-00-231-3161-5
8. Mittle, V.N.; Mittle, Arvind; Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2

INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with Maintain electrical systems applying AC and DC circuit fundamentals. Help may be taken in the form of charts, simulation packages to develop clear concepts of the subject.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, model/prototype making
- Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva voce.

PRACTICAL	3.5 DIGITAL ELECTRONICS (Lab)	L T P
		- - 4

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.

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

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.

LIST OF EXPERIMENTS

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

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.

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
1.	Objective	5
2.	Circuit Diagram	5
3.	Procedure and Connections	5
4.	Observation Table and Calculation	5
5.	Result and its Discussion, Conclusion	10
6.	Viva-Voce	10
	Total	**40**

PRACTICAL	3.6 ELECTRICAL MACHINE-I	L	T	P
		-	-	4

COURSE OBJECTIVES

The objective of an Electrical Machines- I Practical Course is to provide hands-on experience in understanding and implementing fundamental concepts of Electrical machines. The course aims to familiarize students with the testing and operation of DC machines and Transformer. It emphasizes the practical application of DC machines and Transformer through laboratory experiments. Practical aspects of the practical will make the students capable of performing various tests on the machines as per latest BIS specifications.

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

CO1: Perform load tests on DC Shunt Motor and DC Series Motor and explore armature and field control methods for speed modulation.

CO2: Perform Load tests on DC Shunt Generator and DC Series Generator and interpret characteristic curves.

CO3: Conduct OC Test, SC Test and Load tests on single-phase transformers to evaluate their performance characteristics.

CO4: Analyze Parallel operation of transformers.

CO5: Determine Regulation and efficiency of single phase of transformer.

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	1	1	1	-	-	1	*	*
CO2	3	2	1	2	-	-	1	*	*
CO3	3	2	2	2	-	-	-	*	*
CO4	3	2	2	-	-	-	-	*	*
CO5	2	2	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.

LIST OF PRACTICALS (To perform any Ten practical)

1. Reverse the direction of rotation of the DC shunt motor.
2. Perform brake test on DC shunt motor.
3. Control the speed of DC shunt motor by different methods.
4. Control the speed of DC series motor by different methods.
5. Perform the brake test of DC series motor.
6. No load and Full Load Characteristics of Self Excited DC Shunt Generator.
7. Load Characteristics of Self Excited DC Series Generator.
8. Determine regulation and efficiency of single-phase transformer by direct loading.
9. Perform open circuit and short circuit test on single phase transformer to determine voltage regulation and efficiency.
10. Finding the Equivalent Circuit Constants of Single-Phase Transformer by conducting O.C and S.C Tests.
11. Perform parallel operation of two single phase transformers to determine the load current sharing, apparent and real power load sharing.
12. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.
13. Perform polarity test on a single-phase transformer whose polarity markings are masked.
14. Connect the autotransformer in step-up and step-down modes noting the input/output readings.
15. Breakdown Test to determine the Dielectric Strength of Transformer Oil.

INSTRUCTIONAL STRATEGY

Electrical Machine -I 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 various types of electrical motors and transformers which are employed in industry, power stations, domestic and commercial appliances etc. through demonstrations. Following this, they engage in guided experiments and testing circuits. Interactive discussions, problem-solving sessions, and troubleshooting exercises encourage critical thinking. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications.

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
1.	Objective	**5**
2.	Circuit Diagram	**5**
3.	Procedure and Connections	**5**
4.	Observation Table and Calculation	**5**
5.	Result and its Discussion, Conclusion	**10**
6.	Viva-Voce	**10**
	Total	**40**

OPEN ELECTIVE-1

OPEN ELECTIVE-1 (Theory)	3.7 (a) DISASTER MANAGEMENT	L	T	P
		2	-	-

Course Objectives

Following are the objectives of this course:

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organisations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

Course outcomes:

After competing this course, student will be:

- Acquainted with basic information on various types of disasters
- Knowing the precautions and awareness regarding various disasters
- Decide first action to be taken under various disasters
- Familiarised with organisation in India which are dealing with disasters
- Able to select IT tools to help in disaster management

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1								*	*
CO2								*	*
CO3								*	*
CO4								*	*
CO5								*	*

COURSE CONTENT

Unit – I: Understanding Disaster

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire);

Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit- III: Disaster Management Cycle and Framework

Disaster Management Cycle – Paradigm Shift in Disaster Management.

Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Micro zonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness.

During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation –

Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – EarlyRecovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Frame- work of Action.

Unit– IV: Disaster Management in India

Disaster Profile of India – Mega Disasters of India and Lessons Learnt.

Disaster Management Act 2005 – Institutional and Financial Mechanism,

National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies

Unit– V: Applications of Science and Technology for Disaster Management

Geo informatics in Disaster Management (RS, GIS, GPS and RS).

Disaster Communication System (Early Warning and Its Dissemination).

Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions,Structural and Non Structural Mitigation of Disasters

S&T Institutions for Disaster Management in India

TEXT BOOK/ REFERENCE BOOK

1. Publications of National Disaster Management Authority (NDMA) on Various Templates andGuidelines for Disaster Management
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR,New Delhi
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries,Daya Publishers, Delhi
4. Alexander, David, Natural Disasters, Kluwer Academic London

5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

OPEN ELECTIVE-1 (Theory)	3.7 (b) ENERGY EFFICIENCY AND AUDIT	L	T	P
		2	-	-

COURSE OBJECTIVES

The aim of this course is to help the student to attain the following industry identified competencythrough various teaching learning experiences:

Undertake energy efficiency measures and energy audit.

COURSE OUTCOMES:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associatedwith the above mentioned competency:

- Undertake energy efficiency activities
- Use energy efficient pumps, compressors and blowers
- Use energy efficient Air Compressors and DG sets
- Use energy efficient Lighting Systems
- Apply energy efficient electrical machines.
- Use Co-generation and relevant tariff for reducing losses in facilities.

COURSE CONTENTS

Unit – I Introduction to Energy Efficiency

Energy Scenario: Energy demand and supply, National scenario.

Energy Efficiency and Energy Conservation; concepts

Indian Electricity Act 2001; relevant clauses of energy conservationBEE and its Roles

Star Labelling: Need and its benefits.

Unit – II Pumping Systems, Fans and Blowers

Factors affecting pump performance Efficient Pumping system operation

Energy conservation opportunities in Pumping systems Fan types, flow control strategies Fan performance Assessment Energy Conservation opportunities in Pumping systems Tips for energy saving in fans and blowers

Unit – III Air Compressors and Diesel Power Generator sets

Classification of compressors

Pneumatic System components

Effect of various parameters on efficiency of Compressor

Capacity control of Compressors

Checklist for Energy Efficiency in Compressed air systems Operating guidelines for diesel generator, operational factorsEffects of improper ventilation of genset

Energy saving measures for DG sets

Unit –IV Energy Conservation in Lighting System

Replacing Lamp sources

Using energy efficient luminaries

Using light controlled gears

Installation of separate transformer / servo stabilizer for lighting Periodic survey and adequate maintenance programs

Innovative measures of energy savings in lighting

Unit– V Energy Efficient Electrical Machines

Need for energy conservation in induction motor and transformer Energy conservation techniques in induction motor by:

Energy conservation techniques in Transformer Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC),

Energy efficient motor; significant features, advantages, applications and Limitations Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Drytype of transformer

Aggregated Technical and commercial losses (ATC), Technical losses; causes and measures to reduce, Commercial losses: pilferage, causes and remedies, Application of tariff system to reduce energy bill

Co-generation and Tariff; concept, significance for energy conservation

Unit– VI Energy Audit of Electrical Systems

Energy audit (definition as per Energy Conservation Act)

Energy audit instruments and their use Questionnaire for energy audit projects Energy flow diagram (Sankey diagram)

Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.

REFERENCE BOOKS:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi, Edition 2018, (ISBN: 978- 93-86173-683).
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN*: 978-* 0195606539
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., Venkataseshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6. Mehta,V.K.,PrinciplesofPowerSystem,S.ChandandCo.NewDelhi,2016,ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K KatariaandSons,New Delhi ISBN- 13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition

THEORY	4.1 ELECTRIC POWER GENERATION, TRANSMISSION AND DISTRIBUTION	L	T	P
		3	-	-

COURSE OBJECTIVES:

The objective of this course is to enable the student to understand various power generation methods, site selection factors and load management techniques. Analyze AC transmission systems, including components, conductor properties, and overhead line calculations. Introduce HVDC transmission principles, converter stations and integration with renewable and FACTS controllers. Explain line insulator properties, types, and methods to improve string efficiency. Describe underground cable construction and types. Understand distribution system requirements, components and classifications. Identify substation types and key equipment.

Course Outcomes: On successful completion of this course, the student will be able to

CO1 : Describe various generation methods, grid integration and smart grid technologies.

CO2 : Understand the electrical and mechanical parameters of AC transmission system .

CO3 : Explain HVDC transmission and FACTS controllers.

CO4 : Explain the different types of overhead line insulators, construction of underground cables and classification of underground cables.

CO5 : Analyse electrical distribution systems, including substations, bus bar arrangements and AC distribution networks.

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
C01	3	3	-	-	-	-	1	*	*
CO2	3	3	1	-	-	-	-	*	*
CO3	3	2	-	-	1	-	1	*	*
CO4	3	3	-	-	-	-	1	*	*
CO5	3	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.

COURSE CONTENTS

Unit I: GENERATION OF ELECTRICAL POWER (10 Periods)

Methods of Generation: Schematic arrangement and choice of site for Hydel, Thermal, Nuclear power plants - Block Diagram of Diesel, Solar Thermal, Solar Photovoltaic – Solar Cell Technologies – Wind & Pumped storage schemes. Load Management: Grid or Inter connected system – Smart Grid - Load curve - Demand factor - Load factor - Plant Use Factor - Diversity factor – Plant capacity factor – Load Dispatching Centre.

Unit II: A.C TRANSMISSION (08 Periods)

Typical Layout of A.C. Power supply scheme - Elements of a Transmission Line - Over Head Line - Conductor materials and their properties - Line supports and their properties - Types of supports and their applications - Sag in overhead lines - Calculation of Sag - When the supports are at equal and unequal levels - Simple Problems - Constants of a Transmission line - Transposition of Transmission lines - Skin Effect - Ferranti Effect - Corona Formation - Factors affecting Corona - Classification of O.H. Transmission lines - Voltage regulation and Transmission Efficiency (No Problems).

Unit III: HVDC TRANSMISSION & FACTS (08 Periods)

H.V.D.C Transmission: Layout Scheme - D.C Link configurations (Mono polar, Bipolar and Homo polar) - HVDC Convertor Station (Schematic diagram only) – Integration of HVDC & Renewable energy into existing AC grids - HVDC Locations in India. FACTS: Definition - Need for FACTS controllers - Types of FACTS controllers - SVS – STATCOM - UPFC (Block diagram explanation only).

Unit IV: LINE INSULATORS AND UNDERGROUND CABLES (08 Periods)

Line Insulators: Properties of Insulators - Materials - Types - Causes of failure of Insulators - Testing of Insulators - Potential Distribution over suspension Insulator string - String Efficiency - Methods of improving string Efficiency - Problems. Underground Cables: Construction of a three core cable - Classification of cables - Cables for three phase service - Construction of Belted cable, Screened cable, Pressure cables - Laying of underground cables.

Unit V: DISTRIBUTION (08 Periods)

Distribution system - Requirements and parts of Distribution system Classification - Comparison of different distribution systems (A.C and D.C, Overhead & Underground) - A.C Distribution - Types - Connection schemes of AC Distribution system. Sub stations - Classification of sub stations - Indoor and outdoor S.S - Gas insulated S.S – Layout of 110/11KV Substation and 11KV/400V Distribution Substation - Substation equipments - Bus bar - Types of bus bar arrangements.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

TEXT BOOKS/ REFERENCE BOOKS:

1. Gupta, B.R., Generation of Electrical Energy, S. Chand & Co. New Delhi,
2. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9

3. Solanki, Chetan Singh, – Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110
4. Hau**,** Erich, Wind Turbines, Springer-Verlag, Berlin Heidelberg, Germany, ISBN:978-3-642-27150-2
5. Gipe, Paul, Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
6. Wizelius, Tore; Earnest, Joshua – Wind Power Plants and Project Development, PHI
7. Gupta, J.B. A Course in Electrical Power– S. K Kataria and Sons, New Delhi. 2014,
8. Soni, Gupta, Bhatnagar, A Course in Electrical Power. – Dhanpat rai and Sons
9. System, S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	10	24
II	08	19
III	08	19
IV	08	19
V	08	19
Total	**42**	**100**

THEORY	4.2 ELECTRICAL MACHINES-II	L	T	P
		3	-	-

COURSE OBJECTIVES:
The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
•Maintain Induction, Synchronous and Special Electric Machines (SEM) used in different applications.

Course Outcomes: On successful completion of this course, the student will be able to

CO1 : Understand rotating magnetic fields, induction motor principles, construction, characteristics, starting and speed control methods.

CO2: Examine single-phase motor types, maintenance practices.

CO3 : Understand alternator principles, construction, types, EMF equation, and applications and Achieve expertise in voltage regulation, testing, load analysis, and synchronization of alternator.

CO4 : Understand synchronous motor principles, behaviours and its applications

CO5 :, Understand construction of special Electrical Machines and its applications

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	3	3	-	1	-	-	1	*	*
CO2	3	2	-	-	1	-	-	*	*
CO3	3	3	1	1	-	-	-	*	*
CO4	3	2	1	1	1	-	1	*	*
CO5	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.

COURSE CONTENTS

Unit I: Three Phase Induction Motor (10 Periods)

Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip. Locking of rotor and stator fields.
Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor.
Rotor quantities: frequency, induced emf, power factor at starting and running condition.
Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them.
Relationship between rotor copper losses, slip and rotor input power (Power flow diagram)
Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters.
Speed control methods: stator voltage, pole changing, rotor resistance and VVVF.
Motor selection for different applications as per the load torque-speed requirements.
Cogging and Crawling.

Unit II: Single phase induction motors (08 Periods)

Double field revolving theory, principle of making these motors self-start.
Construction, working and Torque-speed characteristics: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor.
Motor selection for different applications as per the load torque-speed requirements.

Unit III: Three phase Alternators (10 Periods)

Principle of working, moving and stationary armatures.
Constructional details: parts and their functions, Windings: Single and Double layer.
Equivalent circuit diagram, E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor.
Necessary conditions of parallel operation of alternators.
Armature reaction at various power factors and synchronous impedance.
Voltage regulation: direct loading and synchronous impedance methods.
Operation of synchronous machine as a motor.

Unit IV: Synchronous Motors (08 Periods)

Principle of working , Torques: starting torque, running torque, pull in torque, pull out torque.
Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical).
Concept of synchronous condenser
V-Curves and Inverted V-Curves. Hunting and Phase swinging.
Methods of Starting of Synchronous Motor.
Losses in synchronous motors and efficiency (no numerical). Applications areas

Unit V: Special Electric Machines (06 Periods)

Construction, working and applications: Linear Induction Motor, Synchronous Reluctance Motor, Switched Reluctance Motor, Permanent Magnet Synchronous Motors, stepper motors, AC and DC servomotors, Submersible motor..

INSTRUCTIONAL STRATEGY

Induction, Synchronous and Special Electric Machines (SEM) being a core subject of electrical diploma curriculum, where a student will deal with various types of **induction motors**, **Alternators, Synchronous Motors and Special Electric Machines** which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these Induction, Synchronous and Special Electric Machines (SEM) used in different applications and give

suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines.

MEANS OF ASSESSMENT

−Assignments and quiz/class tests, mid-term and end-term written tests

TEXT BOOKS/ REFERENCE BOOKS:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-294)
2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education New Delhi, ISBN :9780070593572
3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN:9780070699670
4. Dr. T.D.Bisht - Pooja Yadav , Electrical Machine-II , Asian Publishers Muzaffarnagar, ISBN: 978-93-91541-98-9
5. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN:9789332902855
6. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Delhi, ISBN : 9788121924375
7. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529
8. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New Delhi ISBN: 9788120348806
9. Hughes E., Electrical Technology, ELBS
10. Cotton H., Electrical Technology, ELBS

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	10	25
II	08	18
III	10	25
IV	08	18
V	06	14
Total	**42**	**100**

PRACTICUM	4.3 PROGRAMMING IN C	L	T	P
		1	-	4

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 knorewledge 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.

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

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

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

COURSE CONTENT

UNIT I: Introduction

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
1	Programming exercises on executing and editing a C program.
2	Programming exercises on defining variables and assigning values to variables.

UNIT II: Control Structures

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
3	Programming exercises on arithmetic and relational operators.
4	Programming exercises on arithmetic expressions and their evaluation
5	Programming exercises on formatting input/output using printf and scanf and their return type values.

UNIT III: Functions

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

UNIT IV: Arrays

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
10	Programming exercises on for – statement.
11	Programs on one-dimensional array.
12	Programs on two-dimensional array.
13	(i) Programs for putting two strings together. (ii) Programs for comparing two strings.

UNIT V: Pointers

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

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

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; Apress-e Book distributed by Springer Science and Business Media, New York

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.

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**

Program Elective -1

PRACTICUM	4.4.1 ELECTRONIC INSTRUMENTATION AND MEASUREMENT	L	T	P
		2	-	2

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.

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.

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.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

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

CONTENT

Unit I: Basics of Measurements **(02 Periods)**

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

Unit II: 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
1.	Determine the value of unknown resistance using Wheatstone bridge.
2.	Measure Low resistance by Kelvin's Double Bridge.
3.	Measure unknown inductance using following bridges (a) Anderson's Bridge (b) Maxwell's Bridge.

Unit III: Measuring Instruments **(08 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
4.	List various standard sources & measuring units. Measure DC & AC voltages, current using ammeter and voltmeter.
5.	Test diodes and transistors using analog and digital Multimeter.
6.	Study the working of Q-meter and measure Q of coils.

Unit IV: Oscilloscopes **(08 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
7.	Operate front panel controls of DSO/CRO to observe various waveforms.
8.	Measure time, voltage, frequency, phase difference of input signals using DSO/CRO.
9.	Demonstrate features of digital storage oscilloscope.
10.	Experiment with front panel controls of various signal generators and observe output Waveform.

Unit V: 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
11.	Measure strain/stress using strain gauge measurement.
12.	Measure displacement using LVDT.
13.	Measure temperature using thermistor and thermocouple.
14.	Using a piezo resistive sensor to measure pressure variations/Using a piezoelectric sensor to measure sound vibrations.

TEXT BOOKS/ REFERENCE BOOKS

1. Electrical & Electronic Measurement & InstrumentsA.K. Sawhney, Dhanpat Rai & Sons, India.
2. Electronic Instrument and MeasurementTechnique W.D. Cooper Prentice Hall International,India.
3. Electronic Measurement & Instrumentation J.G. Joshi Khanna Publishing House,Delhi.
4. Measurement systems applicationand 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.

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.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	**Description**	**Marks Allotted**
	Objective	**5**
	Circuit Diagram	**5**
	Procedure and Connections	**10**
	Observation Table and Calculation	**10**
	Result and its Discussion, Conclusion	**10**
	Mini Project	**20**
	Total	**60**

SUGGESTED DISTRIBUTION OF MARKS

Topic	**Time Allotted (Periods)**	**Marks Allotted (%)**
1	2	8
2	4	15
3	8	28
4	8	28
5	6	21
Total	**28**	**100**

Program Elective -1

PRACTICUM	4.4.2 Fundamental of Communication Engineering	L	T	P
		2	-	2

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

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.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

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

COURSE CONTENTS

Unit I: Introduction to Communication Engineering (06 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, Difference between noise and distortion

Modulation: Definition**,** Need of modulation

PRACTICALS:

1. Construct and test the performance of LPF
2. Construct and test the performance of HPF
3. Construct and test the performance of BPF
4. Study of noise and their sources
5. Study of types of modulation and its techniques

Unit II: Amplitude Modulation (08 Periods)

Definition of amplitude modulation, 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 modulator and Demodulator

PRACTICALS:

6. Construct and test the performance of AM Modulator
7. Construct and test the performance of AM demodulation using envelope detector.
8. To obtain an AM wave from a square law modulator circuit and observe waveforms
9. To measure the modulation index of the obtained wave form. Observe under modulated, 100% modulated & over modulated AM

Unit III: Angle Modulation (08 Periods)

Frequency Modulation: Concept of Angle Modulation, Definition of FM modulation, Waveform representation of FM, frequency spectrum, modulation index, maximum frequency deviation and deviation ratio, bandwidth of FM signals.

Phase Modulation: Definition, frequency spectrum, modulation index, comparison of AM, FM, and PM communication systems

PRACTICALS:

10. Construct and test the performance of FM Modulator
11. Construct and test the performance of FM demodulator
12. To obtain an FM wave and measure the frequency deviation and modulation index for different modulating signals.

Unit IV: Pulse modulation (06 Periods)

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

Pulse Digital modulation techniques: Sampling theorem, Nyquist Rate, PCM, Sample and Hold circuit

PRACTICALS:

13. Construct and test the performance of Sample and Hold Circuit.
14. To observe and note the pulse amplitude modulated signal (PAM) and compare them with the corresponding analog input signal.
15. To observe PPM signal and compare it with the analog input signal
16. To observe PWM signal and compare it with the analog input signal

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.

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.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted
1	Objective	5
2	Circuit Diagram	5
3	Procedure and Connections	10
4	Observation Table and Calculation	10
5	Result and its Discussion, Conclusion	10
6	Practical Test	20
	Total	**60**

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted
1.	Objective	5
2.	Circuit Diagram	5
3.	Procedure and Connections	5
4.	Observation Table and Calculation	5
5.	Result and its Discussion, Conclusion	10
6.	Viva-Voce	10
	Total	**40**

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1	06	20
2	08	30
3	08	30
4	06	20
Total	**28**	**100**

Program Elective -2

THEORY	4.5.1 MICROPROCESSOR AND ITS APPLICATIONS	L T P
		3 - -

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.

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.

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.

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

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

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.

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**

Program Elective -2

THEORY	4.5.2 RENEWABLE ENERGY POWER PLANTS	L	T	P
		3	-	-

COURSE OBJECTIVES

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

•Maintain the efficient operation of various types of renewable energy power plants.

Course Outcomes (CO): On successful completion of this course, the student will be able to

CO1 : Compare various solar energy technologies and identify its applications.

CO2 : Infer wind data and compare various large wind energy systems.

CO3 : Develop understanding of Small Wind Energy Systems

CO4 : Identify major components and working of small hydro power plants.

CO5 : Explain various bio-energy technologies and their application.

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

COURSE CONTENTS

Unit – I: Solar PV and Concentrated Solar Power Plants (10 Periods)

Solar Map of India: Global solar power radiation.
Classification of solar thermal collectors, construction and working of (a) flat type, (b) focusing type.
Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors.
Solar Photovoltaic (PV) power plant: components layout, construction, working.
Rooftop solar PV power system, on-grid and off-grid solar PV system.

Unit – II: Large Wind Power Plants (08 Periods)

Wind Map of India: Wind power density in watts per square meter Lift and drag principle; long path theory.
Geared type wind power plants: components, layout and working.
Direct drive type wind power plants: components, layout and working.
Constant Speed Electric Generators: Squirrel Cage Induction Generators (SCIG),
Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).

Unit – III: Small Wind Turbines (08 Periods)

Horizontal axis small wind turbine: direct drive type, components and working
Horizontal axis small wind turbine: geared type, components and working
Vertical axis small wind turbine: direct drive and geared, components and working
Types of towers and installation of small wind turbines on roof tops and open fields.
Electric generators used in small wind power plants

Unit – IV: Micro Hydro Power Plants (08 Periods)

Energy conversion process of hydro power plant.
Classification of hydro power plant: High, medium and low head.
Layouts of micro-hydro power plants
Construction and working of hydro turbines used in different types of hydro power plant: (a) High head – Pelton turbine, (b) Medium head – Francis turbine, (c) Low head – Kaplan turbine.
Pumped storage hydro power plants.
Safe Practices for micro hydro power plants.

Unit – V: Biomass-based Power Plants (08 Periods)

Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste.
Properties of liquid and gaseous fuel for biomass power plants: Jatropha, bio-diesel gobar gas.
Gasifier and its types.
Types of Bio-gas power plant – fixed and floating dome type.
Layout of a Bio-chemical based (e.g. biogas), Thermo-chemical based (e.g. Municipal waste), Agro-chemical based (e.g. bio-diesel) power plant.

INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject, it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment, accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition, viva-voce be conducted to evaluate the knowledge gained during the field visit.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests, model/prototype making

RECOMMENDED BOOKS:

1. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd – Renewable Energy Systems, Pearson Education New Delhi, ISBN: 9789332586826.
3. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
4. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043
5. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
6. Wizelius, Tore &Earnest, Joshua -PHI Learning, New Delhi, ISBN: 978-8120351660
1. Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9
2. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.
3. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-9386173-683)

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	10	24
II	08	19
III	08	19
IV	08	19
V	08	19
Total	**42**	**100**

PRACTICAL	4.6 ELECTRICAL MACHINES-II	L	T	P
		-	-	4

LIST OF PRACTICALS (To perform any Ten practicals)

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.
2. Connect and run the three-phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two).
3. Perform the direct load test on the three-phase squirrel cage induction motor and plot the (a) efficiency versus output, (b) power factor versus output, (c) power factor versus motor current and (d) torque – slip/speed characteristics.
4. Conduct the No-load and Blocked-rotor tests on given 3-phase squirrel cage induction motor and determine the equivalent circuit parameters .
5. Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: (a) auto-transformer, (b) VVVF.
6. Measure the open circuit voltage ratio of the three-phase slip ring induction motor.
7. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.
8. Demonstrate that power factor of an induction motor load is improved by connecting capacitor bank.
9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.
10. Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)
11. Conduct the test on load or no load to plot the ‘V’ curves and inverted ‘V’ curves (at no-load) of 3-phase synchronous motor.
12. Synchronization of 3 Phase Alternators by
    a) Lamp method. b) Synchroscope method
13. Control the speed and reverse the direction of stepper motor
14. Control the speed and reverse the direction of the AC servo motor
15. Control the speed and reverse the direction of the DC servo motor

OPEN ELECTIVE-2

OPEN ELECTIVE-2 (THEORY)	4.7.1 PROJECT MANAGEMENT	L	T	P
		2	-	-

Course Learning Objectives:

- To develop the idea of project plan, from defining and confirming the project goals and objec-tives, identi-fying tasks and how goals will be achieved.
- To develop an understanding of key project management skills and strategies.

Course outcomes:

At the end of the course, the student will be able to:

CO1	Understand the importance of projects and its phases.
CO2	Analyze projects from marketing, operational and financial perspectives.
CO3	Evaluate projects based on discount and non-discount methods.
CO4	Develop network diagrams for planning and execution of a given project.
CO5	Apply crashing procedures for time and cost optimization.

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 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1								*	*
CO2								*	*
CO3								*	*
CO4								*	*
CO5								*	*

Course Content:

UNIT-I: Concept of a project: Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time)project priority matrix- work break down structure.

UNIT-II: Capital budgeting process: Planning- Analysis-Selection-Financing-Implementation- Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: Financial estimates and projections: Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: Basic techniques in capital budgeting: Non discounting and discounting methods- pay- back period-Accounting rate of return-net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**

UNIT-V: Project administration: progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off.

Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management softwares.

Reference Books:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson - McGraw Hill
3. Project management - David I Cleland - Mcgraw Hill International Edition, 1999
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Peason Publication

OR

OPEN ELECTIVE-2 (THEORY)	4.7.2 ECONOMIC POLICIES IN INDIA	L	T	P
		2	-	-

COURSE OBJECTIVES

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

COURSE OUTCOMES

At the end of the course, the student will be able to:

CO1 Understand Indian economics policy, planning strategies

CO2 It will enable to students to comprehend theoretical and empirical development acrosscountries and region for policy purposes

CO3 Development Economics as a discipline encompasses different approaches to the problemsof unemployment, poverty, income generation, industrialization from different perspec- tives

CO4 Able to identify the problems and capable to decide the application for future development

CO5 Analyze economic issues and find solutions to complex economic problems and take cor-rect economic judgment

COURSE CONTENT:

UNIT-I: Basic features and problems of Indian Economy: Economic History of India; Nature of Indian Economy, demographic features and Human Development Index, Problems of Poverty, Unemploy- ment, Inflation, income inequality, Black money in India.

UNIT-II: Sectoral composition of Indian Economy: Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

UNIT-III: Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

UNIT-IV: Economic Policies: Economic Planning in India, Planning commission v/s NITI Aayog, FiveYear Plans, monetary policy in India, Fiscal Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India

UNIT-V: External sector in India: - India's foreign trade value composition and direction, India Bal- ance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

Reference Books:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy. S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri (2017). Indian Economy and –Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India, Oxford University Press.

OPEN ELECTIVE-2

OPEN ELECTIVE-2 (THEORY)	4.7.3 ELECTRIC VEHICLE	L	T	P
		2	-	-

COURSE OBJECTIVES

This course is designed to give a strong understanding of electric vehicle technology, government policies, and the impact on the economy and environment. This course provides hands on experience on various systems and subsystems. It helps students to understand various calculations used in EV and provides guidelines for selection of motor, motor controller, battery pack, battery management system, charging system and regenerative breaking. It also helps students to have hands on experience on repair and maintenance of Electric Vehicle. Also, this course covers the regulatory requirements, safety guidelines, electrical wiring harness and electrical vehicle testing norms and advancements in Electric Vehicles.

COURSE OUTCOME

1. Ability to understand the industry health and safety guidelines while working.
2. Identify the risk areas of electric vehicles to avoid hazards.
3. Ability to understand the types of electric vehicles used in the market.
4. Ability to Identify the electric vehicle Components and their respective functions.
5. Understanding of basic EV calculations.
6. Ability to trouble shoot the components faults in electric vehicle.
7. Enhances knowledge of electrical vehicle systems and their components.
8. Design and Assembly of electric vehicle components for basic vehicle systems.
9. Ability to understand the safety issues involved in operating an electric vehicle.
10. Knowledge to connect safe connections of Wiring harness to avoid future hazards.
11. A working knowledge of the various techniques for performing electric vehicle system trouble-shooting, repairs, and maintenance.
12. Ability to understand the regulatory requirements for Automobile.
13. Ability to construct a brainstorming study to produce numerous innovative thinking.
14. Case study based on innovative products.

CONTENTS:

Sr No	Course contents
1	**Introduction to Industrial Safety Practices** • Fire Extinguishers & its Types • Safely handling Tools & Equipment • Use of proper Tools & Equipment & its maintenance • OSH & practices to be observed as a precaution
2	**Introduction to Electric vehicle** • Overview electric Vehicle Technologies • India policy regarding electric vehicles • Electric vehicle advantages and limitations • Electric vehicle effects on the economy and environment
3	**Electric Vehicle Architecture** • 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.
4	**Electric Vehicle Motors & Controller** • 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

5	**Energy Storage System & Charging System** • 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
6	**Electric Vehicle Battery Management System and Basic Regulatory Requirements** • 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.
7	**Electric Vehicle Circuit Protection and Safety** • 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.
	Repair and Maintenance of EV • Preventive Maintenance of EV • Standard procedure to work on high voltage systems • Diagnosis and fault finding • Schedule Servicing of EV • Predictive Maintenance of EV
8	**Electric Vehicle testing and technology advancement in electric vehicle**

	• 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).

LIST OF PRACTICALS

1. List the industrial safety procedures.
2. Identify the different parts, components & assemblies of electric vehicles, and explain its function.
3. Perform safe storage, handle, and dispose of high voltage battery systems
4. Replace defective Battery Module of 48V Module Systems.
5. Arrange batteries (lead acid) in series configuration to achieve specific requirement.
6. Arrange batteries (lead acid) in parallel configuration to achieve specific requirement.
7. Arrange batteries (lead acid) in series and parallel configuration to achieve specific requirement.
8. Sketch architecture of EV and list the important components, its function, and specifications of each component. (Motor, Motor Controller, Battery Pack, Battery Management System, charging system, etc.)
9. Remove and install rotor from stator.
10. Assume a simple Electric vehicle and calculate power requirement for selecting EV Motor (make necessary assumptions).
11. Assume a simple Electrical vehicle and calculate Battery capacity requirement for selected EV Motor (make necessary assumptions).
12. List out various safety systems, sensors & controllers used in electric vehicles.
13. Assembly & disassembly of electric vehicle components.

14. Compare specifications of any two Electric vehicles (Motor Type, Peak Power, Torque, Battery Capacity, Range etc.)
15. Compare Electric Vehicle Architecture of two different vehicles.
16. Disassemble and Assemble EV Motor.
17. Draw the sketch of various components of EV Motor and list the function of each component.
18. Disassemble and Assemble EV Motor Controller.
19. Disassemble and Assemble DC – DC controller.
20. List of requirements for charging inputs for different types of chargers.
21. Connecting battery to a charger for charging, inspecting a battery after charging. Prepare a table and note the reading.
22. Study the EV motor assembly for issues like noise, shudder, overheating, etc. with performance.
23. Draw a simple wiring diagram of electric vehicle.
24. Perform EV repair and maintenance.
25. Perform basic preventive maintenance.
26. Prepare a list for regulatory requirements.
27. Prepare a list for advancements in electrical vehicle.
28. Case studies
29. Mini project

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

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.

8- GUIDELINES FOR ASSESSMENT OF STUDENT-CENTRED 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-

15 Marks for general behaviour and discipline

(by HODs in consultation with all the teachers of the department)

10 Marks for attendance as per following:

(by HODs in consultation with all the teachers of the department)

a) 75 - 80% 06 Marks

b) 80 - 85% 08 Marks

c) Above 85% 10 Marks

25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSS activities as per following:

(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

a) 25 - State/National Level participation

b) 20 - Participation in two of above activities

c) 15 - Inter-Polytechnic level participation

9- RESOURCE REQUIREMENT

A- LAB INSTRUMENT/ EQUIPMENT LIST

Digital Electronics

Sr.No.	Equipment	Specification	Aproxx. Qty
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 digit), I : ± (1% + 3 digit) • Protection: Built-in overheat, over voltage protections. • Input Supply: 230 AC ± 10% /50-60 Hz	6
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.	
3	Electronic Digital Multimeter	• TRMS • Auto / Manual Ranging • 19999 Count • LCD with Backlight • Auto Power Off • Capacitance • Frequency • Duty Cycle • 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) • 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 Units: 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	
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. 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 DECOD-	

		ER/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, Flipflops, SISO SIPO PIPO PISO shift registers	8
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	1

ELECTRONICS WORKSHOP			
S.no	**Instruments**	**Specification**	**Quantity**
1	Hand Tools set	---	5
2	Soldering set	----	5
3	Hand drill	-----	1
4	PCB Etching machine	Size-400 mm*300 mm, double - sided board, temperature :room temp-(- 55 ^{0}C) adjustable, working power AC 220 V/50 Hz, 1800 watt.	2
5	Silk screen printing	Printer capability 10 sec per cycle, speed-0-200 mm/sec, accuracy-± 0.05 mm	2 set
6	Drafting Equipment	----	1 set

7	PCB Drilling machine	----	1
8	Circular Saw-	----	1
9	DC Regulated low voltage variable 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 digit), I : ± (1% + 3 digit) • Protection: Built-in overheat, over voltage protections. • Input Supply: 230 AC ± 10% /50-60 Hz	2
10	Audio oscillator	• Sine wave 0-10 V • Square wave 0-15 V p/p • Output impedance 600 ohm	2
11	RF signal generator	Frequency range : 0.1Hz - 5MHz Display : 6 digit LED display Output waveforms : Sine, Triangle, Square, ± Pulse, ± Ramp Voltage Control Frequency (VCF) capability,TTL/CMOS and OUTPUT, Output Impedance : 50E Output Amplitude : 20Vp-p(open circuit) ,10Vp-p(with 50 E load) DC Offset : 0 to ± 1OV continuously adjustable Symmetry Range : 90:10 - 10:90	2
12	Digital LCR-Q meter	Variables Measured: L, C, R & Q. 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.)	2

13	Digital Multimeter	DC Voltage : 0.1mV~1000V, AC Voltage : 0.1mV~750V, DC Current : 0.1uA~20A, AC Current : 0.1uA~20A, Ressistance : 0.1ohm~40MOhm	6
14	Dual Trace CRO/ 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 • 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. **DSO probe.** • Total: 10 Unit • Coaxial cable • Characteristic impedance: 50-52Ω • Series: RG58 C/U cable	4
15	AC Millivoltmeter	Voltage -10 µV -100 V Frequency – 10 Hz-1 Mhz band 300 µV full scale sensitivity Dual channel	2
16	IC Bread boards	• 20 unit High Quality breadboard • Breadboard Dimension: ≤ 5. cm x 16 cm x 1cm • Points: ≤800 points	6
17	Soldering stations temperature controlled	ESD safe, lead-free iron with printed ceramic heater	qs

		2) Microcontroller-based smart circuit design. 3)Sleep function to save energy and conserve the bit. B) Hot Air Gun: 1)High Capacity heater with temperature sensor for uniform and fast heating. 2)Blower on the handle with speed control makes it lightweight, efficient, and easy to use. 3)When placed in the cradle, the hot air gun heater switches off automatically and starts the fan to cool it. Watts 600 watts all combinedIron 60watts 480ºC max.Hot air blower 550 watts max 450ºC max. Input Voltage (V AC) 230 1 x Soldering Iron 1 x Hot Air Gun 1 x Station 3 x Nozzles of Different Sizes 1 x Stand with Sponge 1 x Supply Cord 10 different Sizes Bits	
18	Solder suckers with accessories	-----	10
19	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	2

Electrical Machine,

S. No.	Name of Equipment, Tools	Broad Specifications	Quantity

	and Software		
	AC Ammeter	Range(0-5-10-20A),Portable analog MI type	4
	AC Voltmeter	Range(0-75/150/300V), Portable analog MI type	4
3.	AC Voltmeter	Range(0-150/300/600V),Portable analog MI type	4
4.	Wattmeter	0-2.5/5A,0-75/150/300VPortableWattmeter	2
5.	Wattmeter	0-5/10/20A,0-150/300/600VPortableWattmeter	2
6.	Single phase autotransformer	0-230V/0-270V,2 Amp	2
7.	Single Phase transformer	220V, 1kV	2
8.	3 phase Auto transformes	3 phase,5KVA,0-470V, 50 Hz	2
9.	Three phase variable Lamp load	20A, 10kW	2
10.	Three phase variable Inductive load	415 V, 0-10Amp, 50 Hz	1
11.	Rheostat	(0-500 Ohm,1.2A) (0-100 Ohm,5A) (0-50 Ohm,10A) (0- 350 Ohm,1.5A) Ni chrome wire wound rheostat on epoxy resin or class F insulating tube with two fixed and one sliding contact	2 each
12.	Single phase lamp load	1 KW, 4 Amps	
13.	Single Phase induction motor	Capacitor start with centrifugal switch 1.5 KW	1
14.	Three phase induction motor	Cut section model, Squirrel cage type, Three phase, 3 KW,415V,1440RPM	1
15.	Three phase Squirrel Cage induction motor with loading arrangement	Squirrel cage type, Three phase, 3 KW,415V,1440RPM all six terminal brought out, digital voltmeter, ammeter, rpm meter, wattmeter, DOL starter on appropriate panel complete with brake loading arrangement etc.	1
16.	Three phase slip ring induction motor with external resistor bank	Three phase, slip ring type, 3KW, 415 volt, 50 Hz, 1440 RPM with stator and rotor terminals brought out , coupled with a dc shunt generator (230 volt, 3 KW) and with measuring devices (digital voltmeter, ammeter, rpm meter, wattmeter), starter and with appropriate panel.	1
17.	a. DOL Starter b. Star Delta Starter c. Auto transformer starter	a) DOL starter, suitable for 415V, 3 Phase, 50 Hz, 3kw induction motor b) Auto transformer starter for 3 phase, 415 V, 50 Hz,3 Kw induction motor with facility of tappings c) Star-delta starter suitable for 415V, 3 Phase, 50 Hz, 3 kw induction motor (i) Manual (ii) Automatic	1 1 1
18.	Synchronous motor	Synchronous Motor (3HP , 3Phase 415V AC 50Hz, 1440rpm)Coupled with DC Shunt Generator	1

		2KW DC Shunt Generator 230V, 1500 rpm with ammeter, voltmeter, power Factor Meter on panel. Also provide excitation voltage controller with knob to control the Excitation Voltage. Complete panel for calculating V curve.	
19.	Alternator	3 phase 440 volt, 3 KW, 50 HZ alternator with prime mover along with appropriate panel.	2
20.	Alternator Synchronizing panel	Alternator Synchronizing panel with synchroscope and lamp method arrangements	1
21.	Single phase induction motor	Capacitor start with centrifugal switch 1.5 KW, digital voltmeter, ammeter, wattmeter, RPM meter with suitable loading arrangement and appropriate panel board.	1
22.	Capacitor Bank	(2 KVAR,1000V)	2
23.	Experimental kit: control speed and direction reversal of the AC Servomotor	230V, 50 Hz, Servo motor	1
24.	Experimental kit: control speed and direction reversal of the DC Servomotor	DC Servomotor kit	1
25.	Experimental kit: control speed and direction reversal of the Stepper Motor	230V, 50 Hz, stepper motor	1
26.	Tachometer	Tachometer: Digital non-contact type, 0- 10,000 rpm	2
27.	DC shunt Motors with starter and mechanical load arrangement	220 V, 3 HP, 1500 RPM	1
28.	DC shunt Motors with starter	220 V, 3 HP, 1500 RPM	1
29.	DC series motor with starter and mechanical load arrangement	220 V, 2.5 kW,2000 RPM	

Programming in C

Sr.No.	**Equipment**	**Specifications**	**Qty.**
1.	Computer Desktop	I7 8th Generation, 1TB HDD,8GB RAM, Preloaded Windows with 5 years Warranty	30
2.	Online UPS	6VA with Battery	02
3.	Switch	24 Port 10/100/1000 (Manageable)	01
4.	Connectors	RJ-45, RJ-11,BNC,SC,ST	LS

5.	Cables	UTP,STP,OFC 25m each	LS
6.	MFP		01
7.	Router		01
8.	Computer Server	Quad core, Intel processor, 32Gb RAM	
9.	Modem with Router		01
10.	Hardware kit	For computer assembling and disassembling	08
11.	External HDD	-	04
12.	Internet Connectivity	-	30 Nodes
13.	Computer system demonstration kit	-	01
14.	Printer Demonstration Kit	-	01
15.	SMPS Demonstration Kit	-	01
16.	Unmanaged Switch	-	04
17.	Hub	-	02
18.	Air conditioner	2 Tones	02
19.	Miscellaneous	Cables, Connectors, Computer Stationary, Toner Cartridge, Ink Cartridge	LS
20.	Python IDE(py charm/ Eclipse with Py Dev/VS code etc.	Freeware	-
21.	Ms Office Latest or equivalent FOSS	Office (Freeware	
22.	Compile Turbo C, C++ or equivalent FOSS	-	01
23.	Web Camera, Mike, Speaker	LS	LS

ELECTRONIC INSTRUMENT AND MEASUREMENT

Sr. No.	Equipment	Specifications	Aproxx. Qty Required
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
2	Analog Multimeter	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
3	Maxwell'S Inductance Bridge	Frequency: 1KHz +-3%, amplitude 0- 15Vpp.Power: +-5V+-12V & +5V/ 500mA.	2
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
5	WheatStone Bridge Trainer Kit	Power Supply: 12V DC , Phase: single phase, Interface: NO, Automation Grade: Manual, Capacity: 50Hz, Channels: Dial Box	2
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
7	LCR-Q METER	Variables Measured: L, C, R & Q. 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.)	2
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
9	Function Generator	Waveform- sine,Frequency-0 - 15MHz, Type-Digital	2
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
11	Transducers: Pressure type, thermocouple, LVDT, opto Pick-up, electromagnetic pick-up, ultrasonic pick-up and potentiometer etc		LS

12	Thyristor control experimental kits Instrumentation/Transducer experimental kit. Basic electronic experiment kit		LS

Fundaments of Communication Engineering Lab

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 Modulation : Using VCO Frequency Demodulation : Using PLL	2	20000
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

Electrical Circuit

S.N	Equipment Name with Broad Specifications	Aproxx. Quantity
1.	DigitalStorageOscilloscope:DualTrace50Mhz	02
2.	Variable Frequency Generator	02
3.	Variable Resistance Box, 230 V suitable range	05
4.	Variable Capacitance Box 230Vsuitablerange	05
5.	Variable InductanceBox230Vsuitablerange	05
6.	Three phase Balanced (Star Connected) Load (R-L), 3 kVA	01
7.	Three phase Balanced (Delta Connected) Load (R-L) , 3 kVA	01
8.	Auto Transformer:3-Phase,5kVA	02
9.	DC Regulated Power Supply	05
10.	Trainer Kit for Superposition Theorem	04
11.	Trainer Kit for Thevenin's Theorem	04
12.	Trainer Kitfor Norton's Theorem	04
13.	Trainer Kit for Maximum Power Transfer Theorem	04
14.	Wattmeter:SinglePhase,5/10Amp,250/500V	05
15.	Wattmeter: Single Phase 2.5/5Amp, 200/400 V	05
16.	Rheostat- 18 ohm /10A, 250 ohm / 2A, 500 ohm /1A, 720 ohm / 0.8A, suitable range	02 each
17.	Ammeters MI Type: AC/DC,0-5-10Amp,0-1.5Amp,0-2.5Amp,0-0.5-1Amp	03 each
18.	Voltmeter MI Type: AC/DC,0-150/300V, 0-250/500V,0-75/150V	03 each
19.	Auto Transformer:1-Phase,1kVA,230V	02
20.	Digital Multimeter suitable range	06
21.	Three phase power factor meter, power factor (0.5-1-0.5), 440 V	02

B - Furniture Requirement

Norms and standards laid down by AICTE -APH (latest) be followed for working out furniture requirement for diploma courses

C- Human Resources:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE.

10 - List of Participants / Experts

The following experts participated in various workshop for Developing the Curriculum's Structure and Contents of **Electrical and Electronics Engineering** at I.R.D.T. Kanpur.

1- Smt. Geeta Goutam, HOD Electronics, Govt. Poly. Sumerpur, Hamirpur.
2- Smt. Priyanka Tiwari, HOD Electrical, Govt. Poly. Ayodhiya.
3- Dr. Preeti Sonkar, Lecturer Electrical, Govt. Poly. Kanpur.
4- Shri Rajesh Kumar, Lecturer Electronics, Govt. Poly. Deeh sadar Unnav.
5- Smt. Yushra Siddique, Lecturer Electronics, Govt. Poly. Unnav.
6- Shri Vivek Anand Verma, Lecturer Electrical, Govt. Poly. Jigarsand, Balia.
7- Shri Yogesh Singh, Lecturer Electrical, Govt. Poly. Deeh sadar, Unnav.

11 . EVALUATION SCHEME

For Theory Courses:

(The weightage of Internal assessment is 40% and for End Semester Exam is 60%) The student has to obtain at least 40% marks individually both in internal assessmentand end semester exams to pass.

a. For Practical Courses:

(The weightage of Internal assessment is 60% and for End Semester Exam is 40%) The student has to obtain at least 40% marks individually both in internal assessmentand end semester exams to pass.

b. For Summer Internship / Projects / Seminar etc.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Note: The internal assessment is based on the student's performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.