Final

DIPLOMA CURRICULUM OF ELECTRICAL ENGINEERING (THIRD YEAR) (5th Semester)

(To be implemented from 2026-27)

Prepared by;

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Vetted by:
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PROGRAMME TITLE: ELECTRICAL ENGINEERRRING

SEMESTER-V

SL. No	Category of Course	Code No	Course Title	Study Scheme				Evaluation Scheme				Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory		Practical			
					L	T	P	End Exam	Progressive Assessment	End Exam	Progressive Assessment		
1	Programme Core	EEPC301 TH:1	Digital Electronics and Microprocessor		3	0	0	70	30	-	-	100	3
2		EEPC303 TH:2	Energy conservation and audit		3	0	0	70	30	-	-	100	3
3		EEPC305 PR:1	Digital Electronics and Microprocessor Laboratory		0	0	4	-	-	15	35	50	2
4		EEPC307 PR:2	Energy conservation and audit laboratory		0	0	4	-	-	15	35	50	2
5	Programme Elective	EEPE301 (Any one) TH:3	(A) Industrial Automation & Drives (B) Electric Vehicles (C) Electric Traction		3	0	0	70	30	-	-	100	3
6		EEPE303 (Any one) TH:4	(A) Switchgear and protection (B) Wind and Solar Energy Systems (C) Microcontroller applications		3	0	0	70	30	-	-	100	3
7		EEPE305 (Any one) PR:3	(A) Industrial Automation & Drives laboratory (B) Electric Vehicles Laboratory (C) Electric Traction Laboratory (D) Switchgear and protection laboratory (E) Wind and Solar Energy Laboratory (F) Microcontroller applications Laboratory		0	0	4	-	-	15	35	50	2
8	Open Elective	Open Elective- I OE301 (Any one) TH:5	(A) Universal Human Values (B) Leadership and Management skills (C) Professional Skills		3	0	0	70	30	-	-	100	3
9	Summer Internship	SI301	SUMMER INTERNSHIP II#		0	0	0	-	-	15	35	50	2
10	Major Project	PR301 PR:4	MAJOR PROJECT		0	0	4	-	-	15	35	50	2
TOTAL					**15**	**0**	**16**	**350**	**150**	**75**	**175**	**750**	**25**

#3 – 4 weeks internship after 4th Semester;

***The best of 2 IA conducted in a subject out of 20 marks to be considered. Assignment/ quiz etc. of 10 marks to be treated as part of IA. Besides this, Monthly Test to be conducted for each subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester. Club/Innovation/ Idea Tinkering Activities etc. shall be encouraged to be performed by students beyond the above stipulated hours.**

SEMESTER - V COURSES

TH:1- DIGITAL ELECTRONICS AND MICROPROCESSOR

L	T	P		
3	0	0		**Course Code: EEPC301**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment 30
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : PC

RATIONALE:

This course aims to equip the students with fundamentals of number system, number conversion and familiarise the students with various combinational and sequential circuits, microprocessor and its operation. It provides the study of 8085 architecture, functional diagram details, instruction types with simple programming, addressing modes, interfacing with memories and the timing diagram. Interfacing with peripheral devices like 8255.

LEARNING OUTCOMES:

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

- Apply digital fundamentals, Boolean algebra and its applications in simple digital systems
- Comprehend combinational logic circuits.
- Illustrate analysis and design procedures for synchronous and asynchronous sequential circuits
- Explain the various semiconductor memories and related technology
- Explain the architecture of microprocessor 8085.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Digital Fundamentals** Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates and truth tables, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and QuineMcCluskey method of minimization.	8
II	**Combinational & Synchronous Sequential Circuits** Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder -Multiplexer, Demultiplexers, Decoders, and Priority Encoder. Flip flops – SR, JK, T, D, design of clocked sequential circuits – Design of Counters- Shift registers, Universal Shift Register.	9
III	**Asynchronous Sequential Circuits And Memory Devices** Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).	9
IV	**8085 Processor** Hardware Architecture, pin diagram – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.	9
V	**Programming Processor** Instruction – format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Look up table – Subroutine instructions – stack -8255 architecture and operating modes.	10

REFERENCES:

1.	M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2.	Albert Paul Malvino & Donald P. Leach. Digital principles and applications: McGraw-Hill
3.	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
4.	Ramesh S Gaonkar. Microprocessor architecture programming and applications with the 8085: Prentice Hall
5.	Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

TH:2- ENERGY CONSERVATION AND AUDIT

L	T	P		
3	0	0		**Course Code: EEPC303**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : PC

RATIONALE:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences. This will help students to undertake energy conservation and energy audit.

LEARNING OUTCOMES:

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

- Interpret energy conservation policies in India.
- Implement energy conservation techniques in electrical machines.
- Apply energy conservation techniques in electrical installations.
- Use Co-generation and relevant tariff for reducing losses in facilities.
- Undertake energy audit for electrical system.

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Energy Conservation Basics** • Energy Scenario: Primary and Secondary Energy, Energy demand and supply, National scenario. • Energy conservation and Energy audit; concepts and difference • Indian Electricity Act 2001; relevant clauses of energy conservation • BEE and its Roles, MEDA and its Roles • Star Labelling: Need and its benefits.	7
II	**Energy Conservation in Electrical Machines** • Need for energy conservation in induction motor and transformer. • Energy conservation techniques in induction motor by: • Improving Power quality. • Motor survey • Matching motor with loading. • Minimizing the idle and redundant running of motor. • Operating in star mode. • Rewinding of motor. • Replacement by energy efficient motor	10

	• Periodic maintenance • Energy conservation techniques in Transformer. • Loading sharing • Parallel operation • Isolating techniques. • Replacement by energy efficient transformers. Periodic maintenance. • Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC), Intelligent p. f. controller (IPFC) • Energy efficient motor; significant features, advantages, applications and limitations. • Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Dry type of transformer.	
III	**Energy conservation in Electrical Installation systems** Aggregated Technical and commercial losses (ATC); Power system at state, regional, national and global level. Technical losses; causes and measures to reduce by. a) Controlling I2R losses. b) Optimizing distribution voltage c) Balancing phase currents d) Compensating reactive power flow Commercial losses: pilferage, causes and remedies Energy conservation equipment: Maximum Demand Controller , kVAR Controller, Automatic Power Factor controller(APFC) Energy Conservation in Lighting System a) Replacing Lamp sources. b) Using energy efficient luminaries. c) Using light controlled gears. d) Installation of separate transformer / servo stabilizer for lighting. e) Periodic survey and adequate maintenance programs. Energy Conservation techniques in fans, Electronic regulators.	10
IV	**Energy conservation through Cogeneration and Tariff** • Co-generation and Tariff; concept, significance for energy conservation • Co-generation • Types of cogeneration on basis of sequence of energy use (Topping cycle, Bottoming cycle) • Types of cogeneration basis of technology (Steam turbine cogeneration, Gas turbine cogeneration, Reciprocating engine cogeneration). • Factors governing the selection of cogeneration system. • Advantages of cogeneration. • Tariff: Types of tariff structure: Special tariffs; Time-off-day tariff, Peak-off-day tariff, Power factor tariff, Maximum Demand tariff, Load factor tariff. • Application of tariff system to reduce energy bill.	10

V	**Energy Audit of Electrical System** • 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.	8

REFERENCES:

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, New Delhi
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., Principles of Power System, S. Chand &Co.New Delhi, 2016, ISBN 9788121905947
7.	Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria&Sons,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

PR:1- DIGITAL ELECTRONICS AND MICROPROCESSOR LABORATORY

L	T	P		
0	0	4		**Course Code: EEPC305**
Total Contact Hours				**Laboratory Assessment**
Practical		: 60Hrs	**Total Marks: 50**	End Term Exam 15
				Progressive Assessment 35
Pre Requisite		**: Nil**		
Credit		**2**		Category of Course : PC

RATIONALE:

This course aims to equip students various aspects related to digital electronics and microprocessor to enhance understanding through applications. The students will conceptualized digital fundamentals, Boolean algebra and its applications in digital systems, design of various combinational digital circuits using logic gates, analysis synchronous and asynchronous sequential circuits through practical exposure.

LEARNING OUTCOMES:

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

- Design Logic circuits using basic concepts of Boolean algebra
- Design any Logic circuit using basic concepts of PLDs.
- Develop applications using 8085 Microprocessor.
- Develop 8085 interface using programmable I/O device

DETAILED COURSE CONTENTS

Sr. No.	List of experiments	Allotted time (Hours)
	Cycle I. Digital Electronics	**30**
1.	Verification of the truth tables of TTL gates.	
2.	Verify the NAND and NOR gates as universal logic gates.	
3.	Design and verification of the truth tables of Half and Full adder circuits.	
4.	Design and verification of the truth tables of Half and Full subtractor circuits.	
5.	Verification of the truth table of the Multiplexer 74150.	
6.	Verification of the truth table of the De-Multiplexer 74154.	
7.	Design and test of an S-R flip-flop using NOR/NAND gates.	
8.	Verify the truth table of a J-K flip-flop (7476)	
9.	Verify the truth table of a D flip-flop (7474)	
10.	Operate the counters 7490, 7493.	
11.	Design of 4-bit shift register (shift right).	
12.	Design of modulo-4 counter using J K flip-flop.	
	Cycle II. Microprocessor	**30**
1.	Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and	

	subtraction of two Numbers.	
2.	Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers	
3.	Perform multiplication and division of two 8 bit numbers using 8085	
4.	Write a program to arrange an array of data in ascending and descending order.	
5.	Convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.	
6.	Write 8085 Interfacing Program (a) A/D Interfacing. (b) D/A Interfacing (c) I/O port Communication using 8255	
Atleast ten (10) experiments – Six(6) from Cycle I and four (4) from Cycle II.		

REFERENCES:

Same as EEPC301

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PR:2- ENERGY CONSERVATION AND AUDIT LABORATORY

L	T	P		
0	0	4		**Course Code: EEPC307**
Total Contact Hours				**Laboratory Assessment**
Practical		**: 60Hrs**	**Total Marks: 50**	**End Term Exam 15**
				Progressive Assessment 35
Pre Requisite		**: Nil**		
Credit		**2**		**Category of Course : PC**

RATIONALE:

The aim of this course is to help the student to understand the importance of conservation of energy and to conserve energy the best option is energy audit. Energy audit is a process to determine when, where, why and how energy is used in a plant or building. Collection of these information helps to identify the situation where there is need to improve energy efficiency and decrease production cost.

LEARNING OUTCOMES:

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

- Interpret energy conservation policies in India.
- Implement energy conservation techniques in electrical machines.
- Apply energy conservation techniques in electrical installations.
- Use Co-generation and relevant tariff for reducing losses in facilities.
- Undertake energy audit for electrical system.

DETAILED COURSE CONTENTS

Sr. No.	Practical	Hours
1.	Identify star labelled electrical apparatus and compare the data for various star ratings.	3
2.	Determine the '% loading' of the given loaded Induction motor.	3
3.	Determine the reduction in power consumption in star mode operation of Induction motor compared to delta mode.	3
4.	Use APFC unit for improvement of p. f. of electrical load.	3
5.	Compare power consumption of different types of TL with choke, electronic ballast and LED lamps by direct measurements.	3
6.	Determine the reduction in power consumption by replacement of lamps in a classroom / laboratory.	3
7.	Determine the reduction in power consumption by replacement of Fans and regulators in a classroom / laboratory.	3
8.	Collect electricity bill of an industrial consumer and suggest suitable tariff for energy conservation and its impact on energy bill.	3
9.	Collect electricity bill of a commercial consumer and suggest suitable tariff for conservation and reduction of its energy bill.	3

10.	Collect electricity bill of a residential consumer and suggest suitable means for conservation and reduction of the energy bill.	3
11.	Estimate energy saving by improving power factor and load factor for given cases.	3
12.	Prepare a sample energy audit questionnaire for the given industrial facility.	3
13.	Prepare an energy audit report (Phase-I)	3
14.	Prepare an energy audit report (Phase-II)	3
15.	Prepare an energy audit report (Phase-III)	3
Atleast ten (10) experiments to be performed by each student		

REFERENCES:

Same as EEPC303

PROGRAM ELECTIVE – IV (Any One)

TH:3(a)- INDUSTRIAL AUTOMATION & DRIVES

L	T	P		Course Code: EEPE301(a)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

Industrial automation & drives includes control systems like PLC, SCADA and Drives to manage processes and machinery in industries, replacing human involvement. Industrial Automation aims to improve efficiency, reliability, and safety, while reducing costs and increasing productivity while Drives are devices used to control the speed and torque of electric motors in automation systems. AC drives control AC motors by varying frequency and voltage, while DC drives control DC motors by varying voltage. Hence, drives play a crucial role in industrial automation by enabling precise control over motor speed and torque.

LEARNING OUTCOMES:

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

- Identify different types of automation systems.
- Illustrate interfacing of I/O devices with the PLC modules.
- Write programming using ladder logic for simple applications
- Explain the selection of the suitable motor drives for different applications
- Explain selection of relevant DC motor and AC motor for various electric drive applications
- Explain SCADA and its applications.

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Introduction to Industrial Automation** • Automation: Need and benefits. • Types of automation system: Fixed, Programmable, Flexible • Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives	4
II	**PLC Fundamentals** • Building blocks of PLC: CPU, Memory organization, Input- output modules (discrete and analog), • Specialty I/O Modules, Power supply	5

	• Fixed and Modular PLC and their types, Redundancy in PLC module • I/O module selection criteria • Interfacing different I/O devices with appropriate I/O modules	
III	**PLC Programming and Applications** • PLC I/O addressing • PLC programming Instructions: Relay type instructions, Timer instructions: On delay, off delay, retentive, Counter instructions: Up, Down, High speed, Logical instructions, Comparison Instructions, Data handling Instructions, Arithmetic instructions. • PLC programming language: Functional Block Diagram (FBD), Instruction List. Structured text, Sequential Function Chart (SFC), Ladder Programming. • Simple Programming examples using ladder logic: Language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions. • PLC Based Applications: Motor sequence control, Traffic light control, Elevator control, Tank Level control, Conveyor system, Stepper motor control, Reactor Control Gate trigger circuits – Resistance and Resistance-Capacitance circuits.	10
IV	**Electric Drives** • **Fundamental Concept of Electric Drive** o Need of Electric Drives, Functional Block diagrams of an electric drives. o Types and Functions o Four Quadrant Operation of Motor Drive • **Electric Braking** o Electric Braking of DC motor during lowering of loads and stopping, Regenerative braking, AC and DC rheostatic braking • **Selection of motor power rating** • **DC Motor Drives** o Single phase and three phases controlled DC drives, Dual converter control of DC drives. Chopper controlled DC drives, Close loop control of DC drive o Maintenance procedure. • **Induction Motor Drives** o Stator voltage control, V/f controlled induction motors, Slip power recovery, direct torque control • **Introduction to Synchronous Motor Drives** • **Applications** o Speed control of AC motor /DC Motor.	16
V	**Supervisory Control and Data Acquisition System (SCADA)** • **Introduction to SCADA:** o Typical SCADA architecture/block diagram, Benefits of SCADA o Various editors of SCADA • **Interfacing SCADA system with PLC:** o Typical connection diagram, o Object Linking & embedding for Process Control (OPC) architecture, o Steps in Creating SCADA Screen for simple object,	10

	○ Steps for Linking SCADA object (defining Tags and Items) with PLC ladder program using OPC. • **Applications of SCADA:** ○ Traffic light control, water distribution, pipeline control.	

REFERENCES:

1	Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 : 9781401884260
2	Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN:9780071067386
3	Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978-1936007097
4	Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi.ISBN :9788173194283
5	Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, McGraw-Hill Publishing Company Limited, New Delhi.ISBN:9780070701991
6	Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN :13: 978-0470213995

TH:3(b)- ELECTRIC VEHICLES

L	T	P		Course Code: EEPE301(b)	
3	0	0			
Total Contact Hours			**Total Marks: 100**	**Theory Assessment**	
Theory		: 45Hrs		End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

The aim of this course is to help the student to gain comprehensive understanding of electric vehicles, their components, and the underlying technologies that power them. The curriculum typically covers topics like battery technology, power electronics, electric motor drives, control systems, charging infrastructure, and energy management.

LEARNING OUTCOMES:

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

- Discuss the salient features of Hybrid electric vehicles.
- Interpret the Dynamics of hybrid and Electric vehicles
- Illustrate the process to maintain the DC-DC converters in EV applications.
- Illustrate the process to maintain the DC-AC converters in EV applications
- Explain the parameters to select the batteries for EV applications

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Introduction to Hybrid Electric Vehicles** • Evolution of Electric vehicles • Advanced Electric drive vehicle technology Vehicles-Electric vehicles (EV), Hybrid Electric drive (HEV), Plug in Electric vehicle (PIEV), • Components used Hybrid Electric Vehicle • Economic and environmental impacts of Electric hybrid vehicle • Parameters affecting Environmental and economic analysis • Comparative study of vehicles for economic, environmental aspects	9
II	**Dynamics of hybrid and Electric vehicles** • General description of vehicle movement • Factors affecting vehicle motion- Vehicle resistance, tyre ground adhesion, rolling resistance, • aerodynamic drag, equation of grading resistance, dynamic equation • Drive train configuration, Automobile power train, classification of vehicle power plant • Performance characteristics of IC engine, electric motor, need of gear box	9

	• Classification of motors used in Electric vehicles • Basic architecture of hybrid drive trains, types of HEVs • Energy saving potential of hybrid drive trains • HEV Configurations-Series, parallel, Series-parallel, complex.	
III	**DC-DC Converters for EV and HEV Applications** • EV and HEV configuration based on power converters • Classification of converters –unidirectional and bidirectional • Principle of step down operation • Boost and Buck- Boost converters • Principle of Step-Up operation • Two quadrant converters; multi quadrant converters	9
IV	**DC-AC Inverter & Motors for EV and HEVs** • DC-AC Converters • Principle of operation of half bridge DC-AC inverter (R load, R-L load) • Single phase Bridge DC-AC inverter with R load, R-L load • Electric Machines used in EVs and HEVs, principle of operation, working & control • Permanent magnet motors, their drives, switched reluctance motor • Characteristics and applications of above motors	9
V	**Batteries** • Overview of batteries • Battery Parameters, types of batteries • Battery Charging, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, flywheels • Control system for EVs and HEVs, overview, Electronic control unit ECU • Schematics of hybrid drive train, control architecture • Regenerative braking in EVs	9

REFERENCES:

1	A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House, New Delhi (Ed. 2018)
2	Fuhs, A. E. Hybrid Vehicles and the Future of Personal Transportation, CRC Press,
3	Gianfranco, *Electric and Hybrid Vehicles:* Power Sources, Models, Sustainability, Infrastructure And The Market, Pistoia Consultant, Rome, Italy,
4	Ehsani, M. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press
5	Husain, I. Electric and Hybrid Electric Vehicles, CRC Press
6	Rashid, M. H. Power Electronics: Circuits, Devices and Applications, 3rd edition, Pearson,
7	Moorthi, V. R. Power Electronics: Devices, Circuits and Industrial Applications, Oxford University

TH:3(c)- ELECTRICAL TRACTION

L	T	P		Course Code: EEPE301(c)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	60
				Progressive Assessment	40
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

This course provides a comprehensive overview of electric traction systems, covering fundamental concepts, major components at substation, equipment at control post or switching station in, speed-time analysis, and the dynamics of train motion. Students will gain practical insights and skills applicable to engineering and transportation fields and help the students to maintain electric traction systems.

LEARNING OUTCOMES:

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

- Explain the traction layout and its systems
- Discuss the power supply arrangements.
- Discuss the function of the overhead equipment for electric traction
- Illustrate the process to maintain the different components of the electric locomotive.
- Describe the traction motor and train lighting system
- Explain the signalling and supervisory control systems.

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Basics of Traction** o General description of Electrical Traction system in India. o Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive o Problems associated with AC traction System and remedies for it. o Voltage balance, current balance, production of harmonics, induction effects. o Metro rail system, features	6
II	**Power Supply Arrangements** o Constituents of supply system:- • Substation: layout, list of equipment and their functions • Feeding post: list of equipment and their functions • Feeding and sectioning Arrangements • Sectioning and paralleling post • Sub sectioning and Paralleling post • Sub sectioning post • Elementary section	9

	○ Major equipment at substation, Miscellaneous equipment at control post or Switching station ○ Protection system for traction transformer and 25 kV centenary construction	
III	**Overhead Equipment** ○ Different types of overhead equipment ○ Pentagonal OHE Centenary Construction ○ Different Types of Centenary according to speed Limit ○ OHE Supporting Structure, Cantilever assembly diagram ○ Overhead system- Trolley collector, Bow collector, Pantograph Collector ○ Types and construction of pantograph	8
IV	**Electric Locomotive** ○ Classification and Nomenclature of Electric Locomotive ○ Block diagram of AC locomotive ○ Power Circuit of AC Locomotive ○ Equipment (List and Function only) used in auxiliary circuit of AC Locomotive ○ Loco bogie classification according to wheel arrangements ○ Maintenance of AC systems	8
V	**Traction Motors and Train Lighting** ○ Desirable characteristics of traction motor. ○ Types of motors used for traction with their characteristics and features ○ Control of motors used for traction and methods to control ○ Requirements of braking, types of braking ○ Electric braking, Regenerative braking ○ Systems of train lighting, Single battery, double battery parallel block system ○ SG, HOG, End on generation	8
VI	**Signalling and Supervisory Control** ○ Requirements of signalling systems ○ Types of signals, track circuits ○ Advantages of remote control ○ Systems of remote control, equipment and network ○ Metro rail-supply systems, advantages, schemes in India	6

REFERENCES:

1	G.C. Garg, Utlization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2	Gupta J.B., S. K. Kataria and Son, Utilization of Electric power and traction
3	Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
4	Partab H., Dhanpat Rai and Co, Modern Electric Traction
5	Suryanarayana N.V., New Age International Publishers, Reprint 2010
6	Open Shaw Taylor, Orient Longman ltd., Utilisation of electrical energy.

PROGRAM ELECTIVE – V (Any One)

TH:4(a)- SWITCHGEAR AND PROTECTION

L	T	P		
3	0	0		**Course Code: EEPE303(a)**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment 30
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : PE

RATIONALE:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences. This course will support students to maintain switchgear and protection schemes used in electrical power systems.

LEARNING OUTCOMES:

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

- Identify various types of faults in power system.
- Select suitable switchgears for different applications.
- Explain the test for performance of different protective relays.
- Discuss protection systems of alternators and transformers.
- Discuss protection schemes for motors and transmission lines.
- Explain protection schemes for power system against overvoltage.

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**Basics of Protection** • Necessity, functions of protective system. • Normal and abnormal conditions. • Types of faults and their causes. • Protection zones and backup protection • Short circuit fault calculations in lines fed by generators through transformers • Need of current limiting reactors and their arrangements.	7
II	**Circuit Interruption Devices** • Isolators- Vertical break, Horizontal break and Pantograph type. • HRC fuses – Construction, working, characteristics and applications. • Arc formation process, methods of arc extinction (High resistance and Low resistance), Arc voltage, Recovery voltage, Re-striking voltage, RRRV. • HT circuit breakers (Sulphur-hexa Fluoride (SF6), Vacuum circuit breaker) - Working, construction, specifications and applications.	12

	• L.T. circuit breaker (Air circuit breakers (ACB), Miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB) and Earth leakage circuit breaker (ELCB)) - Working and applications. • Selection of LT and HT circuit breakers (ratings), Selection of MCCB for motors. • Gas insulated switchgear.	
III	**Protective Relays** • Fundamental quality requirements: Selectivity, Speed, Sensitivity, Reliability, Simplicity, Economy. • Basic relay terminology- Protective relay, Relay time, Pick up, Reset current, current setting, Plug setting multiplier, Time setting multiplier. • Protective relays: Classification, principle of working, construction and operation of – Electromagnetic (Attracted armature type, Solenoid type, Watt-hour meter type) relay, • Thermal relay. Block diagram and working of Static relay. • Overcurrent relay-Time current characteristics. • Microprocessor based over current relays: Block diagram, working. • Distance relaying- Principle, operation of Definite distance relays. • Directional relay: Need and operation. • Operation of current and voltage differential relay.	10
IV	**Protection of Alternator and Transformer** • Alternator Protection Faults, Differential protection Over current, earth fault, overheating and field failure, protection. • Reverse power protection. • Transformer Protection Faults, Differential, over current, earth fault, over heating protection, Limitations of differential protection. • Buchholz relay: Construction, operation, merits and demerits.	9
V	**Protection of Motors** • Bus-bar and Transmission Line Motor Faults. Short circuit protection, Overload protection, Single phase preventer. • Bus bar and Transmission line • Faults on Bus bar and Transmission Lines. • Bus bar protection: Differential and Fault bus protection. • Transmission line: Over current, Distance and Pilot wire protection.	7

REFERENCES:

1	Mehta V. K ;Rohit Mehta, Principles of Power System, S .Chand and Co., New Delhi., ISBN: 978-81-2192-496-2.
2	Rao. Sunil S., Switchgear and Protection, Khanna Publishers, New Delhi, ISBN: 978-81-7409-232-3.
3	Singh, R. P., Switchgear and Power System Protection, PHI Learning, New Delhi, ISBN: 978-81-203-3660-5.
4	Gupta. J. B.. Switchgear and Protection, S. K. Kataria and Sons, New Delhi, ISBN: 978-93-5014-372-8.
5	Veerapan, N.,Krishnamurty, S. R., Switchgear and Protection, S .Chand and Co., New Delhi. ISBN: 978-81-2193-212-7.

TH:4(b)- WIND AND SOLAR ENERGY SYSTEMS

L	T	P		Course Code: EEPE303(b)	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PE	

RATIONALE:

The aim of this course is to help the student to attain the industry-identified competency through various teaching-learning experiences, which will enable them to gain knowledge about new and renewable sources of energy and equip them to work with projects and to take up research work in connected areas.

LEARNING OUTCOMES:

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

- Discuss the basics of wind energy conversion and solar energy conversion systems.
- Implement the appropriate power extraction techniques.
- Apply concepts of power electronics to the renewable energy systems.
- Explain the grid integration techniques, and power quality issues.
- Apply the technology and techniques in variety of applications.

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub Topic	Allotted time (Hours)
I	**WIND ENERGY CONVERSION** Wind resources – Nature and occurrence of wind – Power in the wind – Wind characteristics – Principles of wind energy conversions – Components of WIND ENERGY CONVERSION SYSTEM (WECS) – Classification of WECS – Advantages and disadvantages of WECS.	9
II	**WIND ELECTRIC GENERATORS** Characteristics of Induction generators – Permanent magnet generators – Single phase operation of induction generators – Doubly fed generators – Grid connected and standalone systems – Controllers for wind driven self-excited systems and capacitor excited isolated systems – Synchronized operation with grid supply – Real and reactive power control.	9
III	**PHOTO VOLTAIC MODELS** Solar cells and panels – Structure of PV cells – Semiconductor materials for PV cells – I-V characteristics of PV systems – PV models and equivalent circuits-	9

	Effects of irradiance and temperature on PV characteristics.	
IV	**PHOTO VOLTAIC ENERGY CONVERSION SYSTEM** Basic photo voltaic system for power generation – Advantages and disadvantages of photo voltaic solar energy conversion –Application of solar photo voltaic system – Components of PV systems- Design of PV systems- Power conditioning and storage arrangement – Maximum power point tracking (MPPT) – Introduction to string inverters.	9
V	**RECENT ADVANCEMENTS IN WIND AND PV SYSTEMS** Wind farms and grid connections – Grid related problems on absorption of wind – Grid interfacing arrangement – Operation, control and technical issues of wind generated electrical energy – Interconnected operation – Hybrid systems. Recent Advances in PV Applications: Building Integrated PV systems, Grid Connected PV systems, Hybrid systems, Solar cars, Solar energy storage system and their economic aspects.	9

REFERENCES:

1	G.N. Tiwari, "Solar Energy: Fundamentals, Design, Modeling & Application", Narosa Publishing House, 2013.
2	G.D. Rai, "Non-conventional Energy Resources", Sixth Ed., Khanna Publishers, 2018.
3	B.H. Khan, "Non-conventional Energy Resources", Tata McGraw Hill Education India Pvt. Ltd., Third Edition, 2017.
4	D.P.Kothari and K.C.Singhal,"RenewableEnergy Sources and Emerging Technologies", P.H.I. 2nd Ed., 2011.
5	D.S.Chauhan, S.K. Srivastava, "Non – Conventional Energy Resources", 3rd Ed.,New Age Publishers, 2012.
6	Ashish Chandra and Taru Chandra, Non-conventional Energy Resources, 2ndEdn., Khanna Publishers, 2021.

TH:4(c)- MICROCONTROLLER APPLICATIONS

L	T	P		
3	0	0		**Course Code: EEPE303(c)**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment 30
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : PE

RATIONALE:

Automation is used in every field of engineering and Microcontrollers plays a very important role as an inbuilt component of these systems. This course aims to help the students to deal with various microcontroller-based systems and make them able to understand microcontroller based applications.

LEARNING OUTCOMES:

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

- Interpret the salient features of various types of microcontrollers.
- Interpret the salient features of architype of types microcontrollers IC 8051
- Maintain the program features of the Microcontroller based application
- Develop assembly language program
- Develop programs to interface 8051 microcontrollers with LED/SWITCH

DETAILED COURSE CONTENTS

Unit	Topic/Sub-Topic	Hours
I	**Introduction to Microcontrollers Evolution of Microcontrollers**	10
	• Block diagram of Microcomputer, elements of Microcomputer, types of buses • Von Neuman and Harward Architecture • Compare Microprocessor and Microcontrollers • Need of Microcontroller • Family of Microcontrollers and their specifications • Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications and comparison	
II	**Architecture of Microcontroller 8051**	9
	• Block diagram of 8051, function of each block • Pin diagram, function of each pin • Concept of Internal memory and External memory (RAM and ROM) • Internal RAM structure • Reset and clock circuit • Various registers and SFRs of 8051	
III	**8051 Instruction Set and Programs**	9
	• Overview of 8051 instruction set • Various addressing modes • Classification of instructions • Data transfer instructions • Arithmetic instructions • Logical instructions • Branching instructions • Bit manipulation instructions • Stack, subroutine and interrupt related instructions • Programs based on above instructions.	
IV	**Assembly Language Programming**	9
	• Software development steps • Software development tools like Editor, Assembler, Linker, Loader and Hex converters. • Role of various files created at various levels in running a Assembly program using • Simulators like RIDE or KEIL. • Various directives of Assembly language programming • Programs using directives.	
V	**8051 Internal Peripherals and Related Programs**	8
	• I/O ports- List, diagram, read write operation, instructions and related SFRs • Timers/counters – list, related SFRs, programming modes,	

	operations with diagram. • Serial communication- Basics of serial communication, baud rate, related SFRs, programming modes, operations with diagram. • Electrical Engineering Curriculum Structure 164 • Interrupts- related SFRs, types, operations with diagram. • Power saving operation- modes, related SFR.	

REFERENCES:

1. Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi,ISBN: 978-1401861582
2. Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN 978-8177589030
3. Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi, ISBN13: 978-81-203-4392-4
4. Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN- 9780070585959
5. Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN: 9788131759905
6. Mathur; Panda, Microprocessors and Microcontrollers, PHI Learning, New Delhi, ISBN:978-81-203-5231-5
7. Krishna Kant, Microprocessors and Microcontrollers: Architecture programming and System Design, PHI Learning, New Delhi, ISBN:978-81-203-4853-0

Program Electives – VI (Any One)

PR:3(a)- INDUSTRIAL AUTOMATION & DRIVES LABORATORY

L	T	P		Course Code: EEPE305(a)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

This laboratory course allows the students to apply the knowledge learnt in the concerned theory course and develop skills needed to handle various projects or applications as a diploma engineer.

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LEARNING OUTCOMES:

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

- Interface I/O devices with the PLC modules.
- Develop PLC ladder programs for various applications.
- Select the suitable motor drives for different applications.
- Prepare simple SCADA applications.
- Select relevant DC motor / AC motors for various electric drive applications.
- Control the speed and torque of electric motors in automation systems
- Maintain microprocessor/micro controlled electric motors.

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DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical	Hours
	CYCLE - I	
1.	Identify various automation systems available in different appliances/ devices/ machines in industry	3
2.	Identify various parts of the given PLC and front panel status indicators.	3
3.	Use PLC to test the START STOP logic using two inputs and one output.	3
4.	Develop/Execute a ladder program for the given application using following: - timer, counter, comparison, logical, arithmetic instructions	3
5.	Use PLC to control the following devices like lamp, motor, push button switches, proximity	3
6.	Develop / test the Ladder program for sequential control application of lamps/ DC motors.	3
7.	Develop ladder program for Traffic light control system.	3
8.	Develop and test ladder program for pulse counting using limit switch /Proximity sensor.	3

9.	Develop /test ladder program for Automated car parking system.	3
10.	Develop / test ladder program for rotating stepper motor in forward and reverse direction at constant speed.	3
11.	Develop /test ladder program for tank water level control.	3
12.	Develop / test ladder program for control of speed of stepper motor with suitable drivers.	3
	CYCLE - II	
1.	Dismantle the given DC motor / AC motor to identify its different parts	3
2.	Control the speed of DC Motor using armature voltage control / field current control method	3
3.	Control the speed of three phase squirrel cage induction motor using stator voltage control	3
4.	Observe the effect on speed of given D.C. series motor / D.C. separately excited motor by varying armature voltage using step down chopper.	3
5.	Control the speed of the given separately excited motor by changing the firing angle of SCR using single-phase semi converter / full converter and measure the speed.	3
6.	Control the speed of the given three-phase induction motor by using constant V/f method / by varying frequency and plot the graph between speed and frequency.	3
7.	Control the speed of DC motor drives using microcontroller	2
Atleast ten (10) experiments – six(6) from Cycle I and four(4) from Cycle II, to be performed by each student.		

REFERENCES:

Same as EEPE301(a)

PR:3(b)- ELECTRIC VEHICLES LABORATORY

L	T	P		Course Code: EEPE305(b)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

This laboratory oriented course aims to improve the skills related to fundamental knowledge and concept of electric vehicle. It will help the students to gain knowledge about the charging and discharging of electric vehicles and attain the industry-identified competency through hands-on experiences in order to maintain electric vehicles

LEARNING OUTCOMES:

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

- Interpret the salient features of Hybrid electric vehicles.
- Compare the dynamics of hybrid and Electric vehicles through case studies
- Maintain the DC-DC converters in EV applications.
- Maintain the DC-AC converters in EV applications
- Select the batteries for EV applications.

DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical	Hours
1.	Develop block diagram of Electric vehicle and identify parts	3
2.	Case study- Compare minimum four vehicles for economic and environmental analysis	4
3.	Develop schematic diagram of hybrid electric vehicle and identify the components	3
4.	Prepare report on Plug in Electric vehicle by visiting a charging station	4
5.	Inspect and install inverter of given lead acid battery	3
6.	Prepare a report on batteries used from market survey	3
7.	Collect specifications of converters and inverters used for Electric vehicles a single lamp control by two switches	4
8.	Diagnose, repair and maintain battery used in electric vehicle	4

9.	Prepare test procedure for equipment used in Electric vehicle	4
10.	List safety procedures and schedule for handling HEVs and EVs.	3
Atleast eight (8) experiments to be performed by each student.		

REFERENCES:

Same as EEPE301 (b)

PR:3(c)- ELECTRIC TRACTION LABORATORY

L	T	P		Course Code: EEPE305(c)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

The aim of Electric traction Laboratory course is to provide the students a scope for understanding the practical applications of electricity. Electric traction means a locomotion in which the driving force is obtained from electric motors and this has entered into the everyday life of many of us because of its use in service of mass transport like the electric propulsions of vehicles – electric trains, trolley buses, tramcars and in the latest developments such as metro and sky bus. In view of the growing importance and technological developments in this area, it is desirable for the students of Electrical Engineering to have both the theory and laboratory courses dealing with electric traction.

LEARNING OUTCOMES:

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

- Interpret the traction layout and its systems
- Maintain the power supply arrangements.
- Maintain the function of the overhead equipment for electric traction
- Maintain the different components of the electric locomotive.
- Maintain the traction motor and train lighting system
- Maintain the signalling and supervisory control systems.

DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical	Allotted time (Hours)
1.	Dismantle a traction motor	4
2.	Assemble a traction motor	4
3.	Troubleshoot a traction motor	4
4.	Visit electric-traction train lighting system installation, identify components of system and prepare report	4
5.	Visit electric-traction loco shed, investigate working of each section & prepare report	4
6.	Visit to Traction Substation or feeding post (for layout and OHE) and write a report	4
7.	Visit to Railway Station (for signaling and train lighting) and writing a report on visit	4

8.	Draw traction substation Layout on drawing sheet and prepare report	4
9.	Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report	4
10.	Draw Power Circuit of AC Locomotive on drawing sheet and prepare report.	4
Atleast eight (8) experiments to be performed by each student.		

REFERENCES:

Same as EEPE301 (c)

Program Electives – VII (Any One)

PR:3(d)- SWITCHGEAR AND PROTECTION LABORATORY

L	T	P	Total Marks: 50	Course Code: EEPE307(d)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs		End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

Switchgear and protection plays an important role in the Electrical power system. Since the demand of Electrical power is increasing, the job of generation, transmission and distribution of Electrical Energy is becoming very complicated. The modern technique of efficient generation, transmission and distribution is coming up regularly. The uses of inter connected bus (National power grid) is increasing day by day. For the job of operation, maintenance and repair work, the service of electrical technicians are very essential.

LEARNING OUTCOMES:

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

- Identify various types of faults in power system.
- Select suitable switchgears for different applications.
- Test the performance of different protective relays.
- Identify the protection systems of alternators and transformers.
- Explain protection schemes for power system against over voltages.

DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical	Hours
1.	Identify various switchgears in the laboratory and write their specifications.	3
2.	Test HRC fuse by performing the load test.	3
3.	Test MCB by performing the load test	3
4.	Dismantle MCCB/ELCB and identify various parts.	4
5.	Dismantle ACB/VCB and identify different parts.	4
6.	Set the plug and time (with PSM, TSM) of induction type electromagnetic relay.	4
7.	Test electromagnetic over-current relay by performing load test.	3
8.	Simulate differential protection scheme for transformer with power system simulation kit.	3

9.	Test the working of the single phasing preventer using a three-phase induction motor.	4
10.	Simulate transmission line protection by using the impedance relay/over current relay for various faults. (On Transmission Line Protection Simulation Kit).	3
11.	Dismantle Thyrite type arrester and identify different parts.	4
12.	Perform neutral earthing at different substations / locations	4
Atleast ten (10) experiments to be performed by each student.		

REFERENCES:

Same as EEPE 303(a)

PR:3(e)- WIND AND SOLAR ENERGY LABORATORY

L	T	P		Course Code: EEPE307(e)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

The Wind and Solar Energy course aims to provide students the opportunity to learn how power generate from wind source and , working of turbine on different conditions and functions of equipment used in wind power. They also learn how solar panel works on different conditions and the functions of components used to generate power from solar panel. This laboratory-oriented course helps them to apply the theory and principle learnt, thereby, able to attain the relevant competency.

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LEARNING OUTCOMES:

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

- Identify the essential features of wind energy conversion systems and solar energy conversion systems
- Implement appropriate power extraction techniques
- Simulate Wind Energy System and Solar PV Energy System.
- Demonstrate grid integration techniques, and power quality issues.
- Simulate Hybrid (Solar - Wind) Power System.

DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical	Hours
1.	Identify the specified items of a wind farm after watching the video clip.	4
2.	Identify the specified parts inside the nacelle of a large Wind Power Plant (WPP) after watching the	4
3.	Simulation study on Wind Energy Generator.	4
4.	Experiment on Performance assessment of micro Wind Energy Generator.	4
5.	Simulation study on Solar PV Energy System.	4
6.	Experiment on "VI-Characteristics and Efficiency of 1kWp Solar PV System".	4
7.	Experiment on "Shadowing effect & diode based solution in1kWp Solar PV System".	4
8.	Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.	4
9.	Simulation study on Hybrid (Solar-Wind) Power System.	4
10.	Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.	4

11.	Simulation study on Intelligent Controllers for Hybrid Systems.	4
Atleast seven (7) experiments – three (3) from wind power system and four (4) from solar power system, to be performed by each student.		

REFERENCES:

Same as EEPE 303(b)

PR:3(f)- MICROCONTROLLER APPLICATIONS LABORATORY

L	T	P		Course Code: EEPE307(f)	
0	0	4			
Total Contact Hours				Laboratory Assessment	
Practical		: 60Hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : PE	

RATIONALE:

As the progress and advancement in the area of microprocessor and microcontroller is very fast, the study of 8051 microcontroller and applications of microcontroller is very important. This course includes a few laboratory exercises for better understanding of the subject through hands-on-practice.

LEARNING OUTCOMES:

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

- Interpret the salient features of various types of microcontrollers.
- Interpret the salient features of architype of types microcontrollers IC 8051
- Maintain the program features of the Microcontroller based application
- Develop assembly language program
- Develop program to interface 8051 microcontrollers with LED/SWITCH

DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical	Time Allotted (Hours)
1.	Interpret details of Hardware kit for Microcontroller and practice to write and execute programs.	3
2.	Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use.	3
3.	Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data	3
4.	Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input	3
5.	Develop and execute an Assembly language program for Addition of series of 8 bit no., 16 bit result and demonstrate outcome for a given input data	3
6.	Develop and execute Assembly language program for addition/subtraction of 16 bit no/multibit nos. and demonstrate outcome for a given input data	3
7.	Develop and execute Assembly language program for Block transfer from and to Internal/External memory using directives and demonstrate outcome for a given input data.	4
8.	Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data.	4
9.	Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data.	4

10.	Develop and execute Assembly language program for LED blinking/LED sequences using delay/timer mode.	4
11.	Develop and execute Assembly language program to interface LED with microcontroller.	4
Atleast ten (10) experiments to be performed by each student.		

REFERENCES:

Same as EEPE303(c)

OPEN ELECTIVES – I (Any One)

TH:5(a)- UNIVERSAL HUMAN VALUES

L	T	P		
3	0	0		**Course Code: OE 301**
Total Contact Hours				
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment 30
Pre-Requisite		**: Nil**		
Credit		**3**		Category of Course: OE

RATIONALE:

The Universal Human Values (UHV) course aims to help diploma students develop a strong ethical foundation, nurturing responsible individuals who contribute positively to society. In an era driven by rapid technological advancements, it is crucial for students not only to gain technical expertise but also to cultivate values that promote harmony, respect, and sustainability.

LEARNING OUTCOMES:

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

- Identify fundamental human aspirations such as happiness and prosperity.
- Differentiate between the self and the body and understand their respective needs.
- Practice self-reflection to improve decision-making, emotional balance, and personal growth.
- Develop respectful and trustworthy relationships within family, friends, and society.
- Explain the role of values like trust, respect, and love in building strong social bonds.
- Promote cooperation and harmony within communities through ethical practices.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Introduction to Value Education and Human Values -** Concept and Need for Value Education - Understanding the importance of value education in personal and professional life, Differentiating between values and skills. Basic Human Aspirations - Exploring fundamental human aspirations: happiness and prosperity, Methods to achieve these aspirations through right understanding and relationships.	8
II	**Harmony in the Human Being -** Understanding the Self - Differentiating between the 'Self' (I) and the Body, Understanding the needs of the Self and the Body, Harmony of the Self with the Body - Ensuring the harmony of 'I' with the Body, Practices for mental and physical well-being.	8
III	**Harmony in the Family and Society -** Family as the Basic Unit of Society - Understanding values in human relationships, Trust and respect as the foundational values in relationships, Harmony in Society - The concept of an undivided society, Universal human order and world family.	8

IV	**Harmony in Nature and Existence -** Interconnectedness in Nature -Understanding the four orders of nature: material, plant, animal, and human, Mutual fulfillment among these orders, Co-existence in Existence - Holistic perception of harmony in existence, Role of human beings in maintaining environmental balance.	8
V	**Professional Ethics -** Ethical Human Conduct - Integrating values into professional life, Concept of professional ethics and accountability, Case Studies in Professional Ethics - Analyzing real-life scenarios to understand ethical dilemmas, Developing solutions based on universal human values.	8
VI	**Personal Development and Social Responsibility** - Self-Reflection and Self-Exploration - Techniques for self-assessment and personal growth, Setting personal goals aligned with universal values, Social Responsibility - Understanding one's role in society, Participating in community service and social initiatives.	5

REFERENCES:

1.	R. R. Gaur, R. Asthana, G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019.
2.	R. R. Gaur, R. Asthana, G. P. Bagaria, Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019.
3.	A. Nagraj, JeevanVidya: EkParichaya, Amarkantak, 1999.
4.	A. N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
5.	Moral Thinking: An Introduction To Values And Ethics, Vineet Sahu, IIT Kanpur: https://onlinecourses.nptel.ac.in/noc23_hs89/preview

TH:5(b)- LEADERSHIP AND MANAGEMENT SKILLS

L	T	P		Course Code: OE301	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : OE	

RATIONALE:

This course/subject on Leadership and Management Skills for students undergoing Diploma programmes is an exploration in leading and managing people, majorly in education based on sound and acceptable principles and theories for effective leadership. The leadership skills will enable them to take initiative, guide team efforts, motivate peers, and ensure effective collaboration. They'll learn how to delegate tasks, resolve conflicts, and foster a positive team environment. The management skills will help them in organizing tasks, setting timelines, and ensuring efficient workflow within a team.
It is expected that the students will be able to handle projects with better project outcomes and a earn a more productive learning experience. This will benefit their academic journey, future careers, and overall professional development:

LEARNING OUTCOMES:

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

- Explain the principles of management
- Collaborate across cultures for effective team work
- Communicate with people for a positive work culture
- Demonstrate personal dispositions, skills & abilities of a leader
- Undertake the process of change management
- Design training for staff development
- Adapt suitable leadership style for improved work efficiency.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Leadership & Management, concept, principles.** • Definition of leadership, management • Leadership theories • Leadership characteristics • Principles of management • Managerial functions • Leader v/s Manager, Leader/Manager traits and character • Leadership Styles	10
II	**Human Resource Management in Organizations** • Human Resource Management: Meaning, Nature, Objectives, Scope • Job & Job analysis. • Staff Development: Need and Objectives of Staff Development, Approaches • Training & development • Organizational Development: Components of OD process. • Learning organization	10
III	**Personal disposition, skills & abilities of leaders** • Self-awareness • Leadership characteristics, traits • Leadership skills & abilities • Emotional intelligence & its components, importance in leadership • Communication skills for effective leadership, barriers to effective communication, Active Listening, Mindful listening. • Leading & Mentorship – Influencing & mentoring	09
IV	**Leader's role in Motivating, Inspiring and Transformative leadership, nurturing team-work** • Goal setting & leadership • Transformative Leadership, vision & envisioning • Motivational role of leader in people management • Group & team • Team dynamics • Conflict management, strategies in managing conflicts	08
V	**Change Management & Leadership** • Models of change • Forces driving change • Change Management – process, goal, importance • The process of change happening in an organization • Key aspects of leadership in change management – responsibilities of a change leader.	08

SUGGESTED ACTIVITIES:

- Group/individual presentation on the basic principles of leadership and management, Discussion on readings - Individual or group presentation of assigned topics in class on leadership and management principles and theories.
- Activities on Envisioning, Goal setting
- ACTION PLAN to be prepared

REFERENCES:

1.	Theories of Educational Leadership and Management (3rd ed.), by Bush, Tony (2003). SAGE Publications, Ltd.
2.	The inspiring leader: unlocking the secrets of how extraordinary leaders motivate. By Zenger, John, Joseph Folkman, and Scott Edinger (2009). New York: McGraw Hill Press.
3.	Knowing yourself. On becoming a leader: the leadership classic. By Bennis, Warren (2009). New York: Basic Books.
4.	Leading Change. By P. Kotter, Harvard Business, 2012.
5.	The Fifth Discipline. By Peter M. Senge, Crwon Currency, 2006.
6.	The Leadership Sutra: An Indian Approach to Power. By Devdutt Pattanaik, – Penguin Random House, 2017.
7.	Leadership and Management. By Dr. A. Chandra Mohan. Himalaya Publishing House, 2010.

TH:5(c)- PROFESSIONAL SKILLS

L	T	P		Course Code: OE301	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : OE	

RATIONALE:

The term, "Professional skills" carries significant weight in the job market and career development. This open elective course explores various types of professional skills, their significance, and how they can be cultivated and harnessed for career progression. By understanding the landscape of professional skills, student can better position himself or herself for success in the competitive job market. It is crucial to continuously update and adapt the professional skills to stay ahead in a rapidly changing work environment. By investing in professional development, one can enhance employability and open doors to new opportunities.

LEARNING OUTCOMES:

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

- Demonstrate Self-competency and Confidence
- Practice Emotional Competency
- Work in a team work or in collaboration
- Demonstrate problem solving and decision making skills
- Apply time management strategies and techniques effectively
- Apply professional ethics and integrity in professional and personal life

UNIT NO.	CONTENT	ALLOTTED TIME (HOURS)
I Communication Skills:	• Active listening • Verbal and non-verbal communication • Written communication • Presentation skills • Conflict resolution	08
II Teamwork and Collaboration:	• Building trust within a team • Effective collaboration strategies • Role delegation and responsibility sharing • Conflict resolution within a team	08
III Problem-Solving:	• Identifying root causes of issues • Generating solutions and evaluating options	08

	• Decision-making under pressure • Critical thinking skills • Triple constraint issues	
IV Time Management:	• Prioritization and task management • Setting realistic deadlines • Effective time planning and organization	06
V Emotional Intelligence:	• Self-awareness and emotional regulation • Empathy and understanding others' emotions • Managing interpersonal relationships • Motivation • Social skills • Emotional Intelligence (EQ) • Stress management	08
VI Professional Ethics and Integrity:	• Workplace ethics and code of conduct • Confidentiality and data privacy • Professional accountability- • Important Considerations:	05

REFERENCES:

1. Dr. Vitthal Gore: Professional Skills for 21st Century: A Key to Success: Blue Rose- ACADEMIC
2. The ACE of Soft Skills: Attitude, Communication and Etiquette for Success: PEARSON
3. The essence of Leadership: S. Manikutty: Bloomsbury

SUMMER INTERNSHIP – II

L	T	P		Course Code: SI301	
0	0	0			
Total Contact Hours				Internship Assessment	
Internship		0	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre-Requisite		: Nil			
Credit		2		Category of Course: SI	

Duration: 3 to 4 weeks after 4th Semester

RATIONALE:

The Summer Internship course includes activities for promoting industrial interaction at the diploma level in technical institutes. The main aim is to enhance employability skills of the students passing out from Technical Institutions. It allows students to gain direct experience, which cannot be simulated in the classroom environment. Hence, this course aims to create competent professionals for the industry. The internship experience will augment outcome based learning process and inculcate various attributes in a student in line with the graduate attributes defined by the NBA. Students can also use internships to test their interest in and aptitude for different career areas. This enables students to find out where they might fit best in a professional environment.

LEARNING OUTCOMES:

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

- Integrate theory and practice of current technological developments relevant to the subject area.
- Assess interests and abilities in their field of study for exploring career alternatives
- Develop work habits and attitudes necessary for job success.
- Develop communication, interpersonal and other critical skills in the job interview process.
- Identify social, economic and administrative considerations that influence the working environment of industrial organizations

DETAILED COURSE CONTENTS

SUGGESTED ACTIVITIES:

Activity Heads: Industrial/Govt./ NGO/MSME/ Rural Internship/ Innovation / Entrepreneurship

During the summer vacation after 4th semester, students are ready for industrial experience. They may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may either choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. In case student want to pursue their family business and don't want to undergo internship, a declaration by a parent may be submitted directly to the TPO.

As per guidelines of AICTE, assessment to be done based on the following major activity heads:

A. Innovation / IPR / Entrepreneurship

1. Participation in innovation related completions for eg. Hackathons etc. to be evaluated by Faculty Mentor
2. Development of new product/ Business Plan/ registration of start-up to be evaluated by Program Head.
3. Participation in all the activities of Institute's Innovation Council (ICC) for eg: IPR workshop/ Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc., evaluated by President/ Convener of ICC.
4. Work experience at family business – to be evaluated by TPO

B. Internship

1. Internship with Industry/ Govt. / NGO/ PSU/ Any Micro/ Small/ Medium enterprise/ Online Internship to be evaluated by Faculty Mentor/ TPO/ Industry supervisor

PR:4- MAJOR PROJECT

L	T	P		Course Code: PR 301	
0	0	4			
Total Contact Hours				Assessment	
Practical		: 60hrs	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credit		2		Category of Course : Project	

RATIONALE:

The project work is a part of teaching learning process. In this course, the role of teachers is a facilitator or coordinator and the students will select the topic, perform design work, place the indent, procure or purchase the material either from departmental store or from the local market. The leadership quality, co-ordination of job and maintaining good communal harmony is an important factor of this type of activity. Project Work is a learning experience, which aims to provide students with the opportunity to synthesize knowledge from various areas of learning, and critically and creatively apply it to real life situations. This process, which enhances student's knowledge and enables them to acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challenges ahead. The success of the project is not the ultimate goal. The group, who is successful in obtaining the good output, should definitely be credited but they must be evaluated for the other components of the activity.

LEARNING OUTCOMES:

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

- Select suitable topic, problem and plan of action
- Apply theory and practices to investigate and solve industry / society related problems
- Maintain good relation among the peer groups
- Demonstrate leadership quality
- Estimate cost involvement
- Develop plan for effective utilization of time

DETAILED COURSE CONTENTS

GUIDELINES FOR MAJOR PROJECT

- The project work may involve the designing a model or upgrading an existing system. The design is to be implemented into a working model.
- A project work may be carried out by a team of 3 to 5 students with a well-defined role of each student within the team. The group will select a project with approval of team of teachers & the guide.
- Each group must prepare project proposal that includes project title, group members, sponsor details (if any), detailed problem definition, area, abstract, details of existing similar systems if any, scope of the project and software-hardware requirements.

- Major projects should be based on real/ live problems of the Industry/ Govt./ NGO/ MSME/Rural Sector or an innovative idea having the potential of a Start-up. Main objective of the major project is to provide the students with an opportunity to develop a complete project.
- The major project is distributed in two consecutive semesters, students can get ample time to realize a complete project with documentation or transform their ideas of start-ups into reality. The requirement analysis and designing part of the project may be completed in the 5^{th} semester.
- A project report including all necessary documents such as Requirement Analysis, Design specifications, Project Plan, Design Modeling, test plan etc.to be prepared and submitted for progressive assessment.
- For assessment, following components may be considered:
    - Synopsis and Project Title selection
    - Initiative in Performing Project tasks
    - Sense of responsibility and punctuality
    - Outcome of the completed stages of the Project
    - Communication and presentation skills
    - Interpersonal skills
    - Report writing skills
    - Viva voce