DIPLOMA CURRICULUM OF

ELECTRICAL ENGINEERING

(SECOND YEAR)

(3rd Semester)

(To be implemented from 2025-26)

Prepared by;

National Institute of Technical Teachers' Training & Research Kolkata

Block – FC, Sector – III, Salt Lake City, Kolkata – 700 106

Vetted by:

Domain experts from Polytechnics of Odisha

State Council for Technical Education & Vocational Training

Near Raj Bhawan, Unit-VIII, Bhubaneswar, Odisha

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Total 48 Credits and 1500 marks

PROGRAMME TITLE: ELECTRICAL ENGINEERING

SEMESTER - III

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	EEPC201	Introduction to Electric Generation Systems		3	0	0	70	30	-	-	100	3
2		EEPC203	Electrical Circuits		3	0	0	70	30	-	-	100	3
3		EEPC205	Electrical and Electronic Measurements		3	0	0	70	30	-	-	100	3
4		EEPC207	DC Machines and Transformers		3	0	0	70	30	-	-	100	3
5		EEPC209	Renewal Energy Power Plants		3	0	0	70	30	-	-	100	3
6		EEPC211	Programming for Problem Solving		0	0	4	-	-	15	35	50	2
7		EEPC213	Electrical Circuits Laboratory		0	0	4	-	-	15	35	50	2
8		EEPC215	Electrical and Electronic Measurements Laboratory		0	0	4	-	-	15	35	50	2
9		EEPC217	DC Machines and Transformers Laboratory		0	0	4	-	-	15	35	50	2
10	Summer Internship	SI201	Summer Internship – I*		0	0	0	-	-	15	35	50	2
TOTAL					**15**	**0**	**16**	**350**	**150**	**75**	**175**	**750**	**25**

*3 - 4 weeks after 2nd Semester

SEMESTER - III COURSES

INTRODUCTION TO ELECTRIC GENERATION SYSTEMS

<table>
<tr><td>L</td><td>T</td><td>P</td><td rowspan="6">Total Marks: 100</td><td colspan="2">Course Code: EEPC201</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td colspan="2"></td></tr>
<tr><td colspan="3">Total Contact Hours</td><td colspan="2">Theory Assessment</td></tr>
<tr><td colspan="3">Theory : 45Hrs</td><td>End Term Exam</td><td>70</td></tr>
<tr><td colspan="3"></td><td>Progressive Assessment</td><td>30</td></tr>
<tr><td colspan="3">Pre Requisite : Nil</td><td colspan="2"></td></tr>
<tr><td colspan="3">Credit 3</td><td colspan="2">Category of Course : PC</td></tr>
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RATIONALE:

This course concentrates on the field of electric generation systems. It includes thermal power plants: coal, gas/diesel and nuclear-based, large and micro-hydropower plants, solar and biomass based power plants, and wind power plants. After completion of this course, the students will be able to know about economics of power generation and interconnected power system and maintain the efficient operation of various electric power generating plants.

LEARNING OUTCOMES:

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

- Explain the optimized working of the thermal power plant
- Describe the efficient operation of large hydropower plants.
- Describe the efficient operation micro hydropower plants.
- Select the adequate mix of power generation based on economic operation.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Thermal Power Plants: Coal, Gas/Diesel and Nuclear-based** 1.1 Layout and working of a typical thermal power plant with steam turbines and electric generators 1.2 Properties of conventional fuels used in the energy conversion equipment used in thermal power plants: Coal, Gas, Diesel, Nuclear fuels-fusion and fission action 1.3 Safe Practices and working of various thermal power plants: coal-based, gas- based, diesel-based, and nuclear-based 1.4 Functions of the following types of thermal power plants and their major auxiliaries 1.4.1 Coal fired boilers: fire tube and water tube 1.4.2 Gas/diesel based combustion engines 1.4.3 Types of nuclear reactors :Disposal of nuclear waste and nuclear shielding	16
II	**Large Hydropower Plants** 2.1 Energy conversion process of hydro power plant 2.2 Classification of hydro power plant: High ,medium and low head 2.3 Construction and working of hydro turbines used in different types of hydro power plant 2.3.1 High head-Pelton turbine 2.3.2 Medium head-Francis turbine 2.3.3 Low head-Kaplan turbine 2.4 Safe Practices for hydro power plants 2.5 Locations of these different types of large hydro power plants in India	09
III	**Micro-Hydropower Plants** 3.1 Lay out of micro hydro power plants 3.2 Different types of micro-hydro turbines for different heads: 3.2.1 Pelton turbines 3.2.2 Francis turbines 3.2.3 Kaplan turbines 3.3 Locations of these different types of micro-hydro power plants in India	08

IV	**Economics of Power Generation and Interconnected Power System** 4.1 Related terms: connected load, firm power, cold reserve, hot reserve, spinning reserve. Base load and peak load plants; Load curve, load duration curve, integrated duration curve 4.2 Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor 4.3 Choice of size and number of generator units 4.4 Combined operation of power station Causes, Impact and reasons of Grid system fault: State grid, national grid, brownout and blackout; sample blackouts at national and international level.	12

REFERENCES:

1.	Electrical Power Generation by Tanmoy Deb, Khanna Publishing House, Delhi.
2.	Generation of Electrical Energy by B.R. Gupta, S. Chand & Co. New Delhi.
3.	Wind Power Technologies by Rachel, Sthuthi; Earnest, Joshua, PHI Learning, New Delhi.
4.	Solar Photovoltaics: Fundamentals, Technologies and Applications by Chetan Singh Solanki, PHI Learning, New Delhi.
5.	Wind Energy Basics by Gipe Paul, Chelsea Green Publishing Co.
6.	Wind Power Plants and Project Development by Wizelius, Tore, Earnest, Joshua, PHI.
7.	A Course in Electrical Power by J.B. Gupta, S.K. Kataria and Sons, New Delhi.
8.	A Course in Electrical Power by Soni, Gupta, Bhatnagar, Dhanpat Rai and Sons.

ELECTRICAL CIRCUITS

L	T	P		Course Code: EEPC203	
3	0	0			
Total Contact Hours			**Total Marks: 100**	**Theory Assessment**	
Theory		: 45 Hrs		End Term Exam	: 70
Tutorial		: 0		Progressive Assessment	: 30
Pre Requisite		**: Nil**			
Credit		**: 3**		Category of Course : PC	

RATIONALE:

The concept of electrical circuits and networks is very essential for more advanced topics in Electrical and related Engineering programs. This course aims to cover basic circuit concepts, different methods for analyzing large-scale circuits, and applications of these concepts.

COURSE OUTCOMES:

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

- Explain various characteristics of different single phase AC series, AC parallel circuits and terms related to three phase circuits
- Solve problems using network reduction & principles of circuit analysis
- Apply Network theorems in analyzing and solving electrical circuit problems
- Explain the behavior of circuit in transient condition.
- Describe two-port networks

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Single Phase A.C Series Circuits** 1.1 Generation of alternating voltage 1.2 Phasor representation of sinusoidal quantities 1.3 R, L, C circuit elements its voltage and current response 1.4 R-L, R-C, R-L-C combination of A.C series circuit 1.4.1 Impedance, reactance, impedance triangle 1.4.2 Power factor, active power, reactive power, apparent power 1.4.3 Power triangle and vector diagram 1.4.4 Resonance, Bandwidth 1.4.5 Quality factor and voltage magnification in series R-L, R-C, R-L-C circuit	7

II	**Single Phase A.C Parallel Circuits** 2.1 R-L, R-C and R-L-C parallel combination of A.C. circuits 2.1.1 Impedance, reactance, phasor diagram, impedance triangle 2.1.2 Power factor, active power, apparent power, reactive power, power triangle 2.2 Resonance in parallel R-L, R-C, R-L-C circuit 2.3 Bandwidth, Quality factor and voltage magnification	8
III	**Three Phase Circuits** 3.1 Phasor and complex representation of three phase supply 3.2 Phase sequence and polarity 3.3 Types of three-phase connections 3.4 Phase and line quantities in three phase star and delta system 3.5 Balanced and unbalanced load 3.6 Neutral shift in unbalanced load 3.7 Three phase power, active, reactive and apparent power in star and delta system	8
IV	**Network Reduction and Principles of Circuit Analysis** 4.1 Source transformation 4.2 Star/delta and delta/star transformation 4.3 Mesh Analysis 4.4 Node Analysis	5
V	**Network Theorems** 5.1 Superposition theorem 5.2 Thevenin's theorem 5.3 Norton's theorem 5.4 Maximum power transfer theorem 5.5 Reciprocity Theorem	9
VI	**Two Port Network** 6.1 Open Circuit Impedance Parameters 6.2 Short Circuit Admittance Parameters, Transmission Parameters , Hybrid Parameters 6.3 Interrelationship of Two Port Network 6.4 Inter Connection of Two Port Network	8

REFERENCES:

1.	Network Analysis, M. E. Van Valkenburg; Prentice Hall of India
2.	Electric Circuits; David A. Bell; Oxford University Press New Delhi.
3.	Electric Circuit Theory, Chattopadhyay, Rakshit S. Chand &. Co
4.	Network & Systems, D. Roy Choudhury Wiley Eastern Ltd
5.	Networks and Systems, Ashfaq Husain Khanna Publishing House
6.	Engineering Circuit Analysis, W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, McGraw Hill
7.	Fundamentals of Electrical Engineering; S.B Lal Saxena and K.Dasgupta; Cambridge University Press Pvt. Ltd., New Delhi.
8.	Electrical Circuits; Joseph Edminister, Schaum's Outline, Tata McGraw Hill.

ELECTRICAL AND ELECTRONIC MEASUREMENTS

L	T	P		Course Code: EEPC205	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		**: 45Hrs**	**Total Marks: 100**	**End Term Exam**	**: 70**
Tutorial		**: 0 Hrs.**		**Progressive Assessment**	**: 30**
Pre Requisite		**: Nil**			
Credit		**: 3**		**Category of Course : PC**	

RATIONALE:

The subject "Electrical & Electronics Measurements" is important in the field of Electrical Engineering. This subject deals with the technique of measuring voltage, current and wattage by the indicating type of instruments. The technique of measurement of Electrical power in single phase and three phase circuits will be studied here. Measurement of energy and calibration and adjustment of energy meters will also be studied under this subject. Prior to above the working principle construction of all type of measuring instruments like indicating, integrating and recording type will also be studied here.

LEARNING OBJECTIVES:

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

- Explain the construction and working principle of different types of electrical measuring instruments.
- Connect different types of electrical measuring instruments to measure various electrical parameters.
- Select the right instruments for the measurement of voltage, current, power and energy.
- Apply the appropriate technique to measure resistance, inductance and capacitance.

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Fundamentals of Measurements** 1.1 Measurement: Significance, units, fundamental quantities and standards 1.2 Classification of Instrument Systems 1.3 Null and deflection type instruments 1.4 Absolute and secondary instruments 1.5 Analog and digital instruments 1.6 Static and dynamic characteristics, types of errors 1.7 Calibration: need and procedure 1.8 Classification of measuring instruments: indicating, recording and integrating instruments 1.9 Essential requirements of an indicating instruments	**10**
II	**Measurement of voltage and current** 2.1 DC Ammeter: Basic, Multi range, Universal shunt, 2.2 DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity 2.3 AC voltmeter: Rectifier type (half wave and full wave) 2.4 CT and PT: construction, working and applications	**9**

III	**Measurement of Electric Power** 3.1 Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter, their construction, working, salient features, merits and demerits 3.2 Dynamometer type wattmeter: Construction and working 3.3 Errors and compensations of PMMI,PMMC and Dynamometer type wattmeter 3.4 Active and reactive power measurement: One, two and three wattmeter method 3.5 Effect of Power factor on wattmeter reading in two wattmeter method 3.6 Maximum Demand indicator(Definition only)	**9**
IV	**Measurement of Electric Energy** 4.1 Single and three phase electronic energy meter: Constructional features and working principle 4.2 Errors and their compensations 4.3 Calibration of single-phase electronic energy meter using direct loading.	**7**
V	**Circuit Parameter Measurement, CRO and Other Meters** 5.1 Measurement of resistance 5.1.1 Low resistance: Kelvin's double bridge, 5.1.2 Medium Resistance: Voltmeter and ammeter method 5.1.3 High resistance: Megger and Ohm meter: Series and shunt 5.2 Measurement of inductance using Anderson bridge (no derivation and phasor diagram) 5.3 Measurement of capacitance using Schering bridge (no derivation and phasor diagram) 5.4 Single beam/single trace CRO (Working principle and block diagram only) 5.5 Digital storage Oscilloscope**:** Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage/ amplitude/ time period/ frequency/ phase angle delay line, specifications. 5.6 Other meters: Earth tester, Digital Multimeter; L-C-R meter, Frequency meter (ferromagnetic and Weston type), Phase sequence indicator, power factor meter (single phase and three phase dynamometer type), Synchro scope, Tri-vector meter 5.7 Signal generator: need, working and basic block diagram.	**10**

REFERENCES:

1.	A Text Book of Electrical Technology Vol-I (Basic Electrical Engg.) by B. L. Theraja, A. K. Theraja, S.Chand and Co. New Delhi.
2.	Basic Electrical Engineering by V. N. Mittle, Mc Graw-Hill New Delhi.
3.	Electrical Technology by Edward Hughes, Pearson Education, New Delhi.
4.	Electrical and Electronic Measurement and Instrumentation by R.K. Rajput, S.Chand and Co. New Delhi.
5.	Electrical and Electronics Measurements and Instrumentation by A.K. Sawhney, Dhanpai Rai and Sons, New Delhi.
6.	Electrical Measurements and Measuring Instruments by N.V. Suryanarayna, S.Chand and Co., New Delhi.

DC MACHINES AND TRANSFORMERS

L	T	P		Course Code: EEPC207	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		**: 45Hrs**	**Total Marks: 100**	**End Term Exam**	**: 70**
Tutorial		**: 0 Hrs.**		**Progressive Assessment**	**: 30**
Pre Requisite		**: Nil**			
Credit		**: 3**		**Category of Course : PC**	

RATIONALE:

The applications of DC machine in modern industries are still in practice. The Electrical Engineering Technicians has to look after the installation, operation and control of electrical machines. Therefore, the knowledge of "Electrical Machine" is very essential in this regard. This subject covers DC generators, DC motors, single-phase transformers, three phase transformers and special purpose transformers. This subject deals with the working principles, operation of the machines.

LEARNING OUTCOMES:

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

- Explain the construction and working principle of dc machines.
- Describe the performance characteristics of dc motor and dc generator.
- Explain the construction and working principle of transformer.
- Describe the performance of single phase and three-phase transformer.
- Discuss about special purpose transformers

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**DC Generators** 1.1 D.C. generator: construction, parts, materials and their functions 1.2 Principle of operation of DC generator 1.2.1 Fleming's right hand rule 1.2.2 Derive the emf equation of DC Generator 1.2.3 Schematic diagrams of different types of DC generator 1.2.4 Armature reaction 1.2.5 Commutation 1.2.6 Applications of D.C. generators	9
II	**D.C. Motors** 2.1 D.C. motor: Types of DC motors 2.1.1 Fleming's left hand rule 2.1.2 Principle of operation of Back e.m.f. and its significance 2.1.3 Voltage equation of DC motor 2.1.4 Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency	9

	2.2 DC motor starters: Necessity, two point and three point starters 2.3 Speed control of DC shunt and series motor: Flux and Armature control 2.4 Brushless DC Motor: Construction and working	
III	**Single Phase Transformers** 3.1 Types of transformers: Shell type and core type 3.2 Construction: Parts and functions 3.3 Materials used for different parts: CRGO, CRNGO, HRGO, amorphous cores 3.4 Transformer: Principle of operation 3.5 EMF equation of transformer: Derivation, Voltage transformation ratio 3.6 Significance of transformer ratings 3.7 Transformer No-load and on-load phasor diagram, Leakage reactance 3.8 Equivalent circuit of transformer: Equivalent resistance and reactance 3.9 Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency	10
IV	**Three Phase Transformers** 4.1 Bank of three single phase transformers,(Y-Y,Δ-Δ ,Δ-Y, Y- Δ) 4.2 Single unit of three phase transformer 4.3 Distribution and Power transformers: Construction and cooling, 4.4 Criteria for selection of distribution transformer, and power transformer. 4.5 Need of parallel operation of three phase transformer 4.6 Conditions for parallel operation. 4.7 Polarity tests on mutually inductive coils and single phase transformers 4.8 Polarity test, Phasing out test on Three-phase transformer	9
V	**Special Purpose Transformers** 5.1 Single phase and three phase autotransformers: Construction, working and applications. 5.2 Isolation transformer: Constructional Features and applications	8

REFERENCES:

1.	Electrical Machines, Vol-I, II, by G.C.Garg & P.S.Bimbhra, Khanna Book Publishing House, New Delhi.
2.	Basic Electrical Engineering by V.N. Mittle and Arvind. Mittle, McGraw Hill Education, New Delhi.
3.	Electrical Machines by D.P. Kothari, and I.J. Nagrath, McGraw Hill Education, NewDelhi.
4.	Electrical Machines by S.K. Bhattacharya, McGraw Hill Education, New Delhi.
5.	Principles of Electrical Machines by V.K. Mehta, and Rohit Mehta, ,S. Chand and Co.Ltd., New Delhi.
6.	Electrical Technology Vol-II (AC and DC machines) by B.L. Theraja, S. Chand and Co. Ltd., New Delhi.
7.	Electrical Machines Theory and Practice by M.N. Bandyopadhyay, PHI Learning Pvt. Ltd., New Delhi.
8.	DC Machines and Transformers by K. Murugesh Kumar.

RENEWABLE ENERGY POWER PLANTS

L	T	P		Course Code: EEPC209	
3	0	0			
Total Contact Hours				Theory Assessment	
Theory		: 45Hrs	Total Marks: 100	End Term Exam	: 70
Tutorial		: 0 Hrs.		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 industry-identified competency through various teaching learning experiences that will develop the ability to maintain the efficient operation of various types of renewable energy power plants.

LEARNING OUTCOMES:

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

- Explain the construction and working principle of Solar PV and Concentrated Solar Power Plants.
- Describe the components and working principles of large and small Wind Power Plants
- Explain the construction and working principle of Micro-hydro Power Plants
- Discuss the properties of solid, liquid and gaseous fuels for biomass power plants
- Prepare layout for biomass-based Power Plants

DETAILED COURSE CONTENTS

Unit No	Topic/Sub-Topic	Allotted Time (Hours)
I	**Solar PV and Concentrated Solar Power Plants** 1.1 Solar Map of India: Global solar power radiation, Solar PV 1.2 Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors 1.3 Solar Photovoltaic (PV) power plant: components layout, construction, working. Roof top solar PV power system	12

II	**Large Wind Power Plants** 2.1 Wind Map of India: Wind power density in watts per square meter Lift and drag principle; long path theory. 2.2 Geared type wind power plants: components, layout and working. Direct drive type wind power plants: components, layout and working. 2.3 Constant Speed Electric Generators: Squirrel Cage Induction Generators(SCIG), 2.4 Wound Rotor Induction Generator (WRIG); Variable Speed Electric Generators: Doubly-fed induction generator (DFIG), wound rotor synchronous generator (WRSG), permanent magnet synchronous generator (PMSG).	**12**
III	**Small Wind Turbines** 3.1 Horizon axis small wind turbine: direct drive type, components and working Horizontal axis small wind turbine: geared type, components and working 3.2 Vertical axis small wind turbine: direct drive and geared, components and Working Types of towers and installation of small wind turbines on rooftops and open fields. 3.3 Electric generators used in small wind power plants	**09**
IV	**Biomass-based Power Plants** 4.1 Properties of solid fuel for biomass power plants: bagasse, wood chips, rice husk, municipal waste 4.2 Properties of liquid and gaseous fuel for bio mass power plants: Jatropha, bio-diesel gobar gas 4.3 Layout of a Bio-chemical based (e.g. biogas) power plant: 4.4 Layout of a Thermo-chemical based (e.g. Municipal waste) power plant 4.5 Layout of a Agro-chemical based (e.g.bio-diesel) power plant	**12**

REFERENCES:

1.	Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photo voltaic 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, NewDelhi, ISBN:978-93-88028-49-3; E-book978-93-88028-50-9
4.	Khoiyangbam, RS 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
7.	Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN:-978-81-203-4470-9
8.	Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, NewDelhi,ISBN:9780195670936.
9.	O. P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN:978-9386173-683)

PROGRAMMING FOR PROBLEM SOLVING

L	T	P		
0	0	4		**Course Code: EEPC211**
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 is included in the curriculum to develop logical skills and basic programming skills of the students so that they will be able to solve basic computing problems. The students will learn the fundamentals of computer programming language using C Programming and MATLAB programming.

LEARNING OUTCOMES:

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

- Illustrate problem solving using fundamentals of C programming language
- Apply appropriate Control structures to solve problems using C programming
- Demonstrate concept of Arrays and Strings in C programming language
- Apply user defined functions and pointers to solve problems using C programming
- Write simple programs to illustrate application of MATLAB programming in problem solving

DETAILED COURSE CONTENTS

Unit No.	Topic/Sub-Topic
I	**C Programming:** History and importance of C, Basic structure of C program, executing a C program. Constants, Variable and Data Types: Introduction, Character Set, C Tokens, Keywords and Identifiers, Constants, Variables, Data Types, Declaration of Variables, Assigning Values to Variables, Defining Symbolic Constants. Managing Input and Output Operations: Reading a Character, Writing a Character, Formatted Input, Formatted Output. Operators and Expressions: Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators, Special Operators, Arithmetic Expressions, Decision Making and Branching: Introduction, Decision Making with IF Statement, Simple IF Statement, the IF-ELSE Statement, Nesting of IF-ELSE Statements,

	Decision Making and Looping: Introduction, The while Statement, The do statement, The for statement, Arrays: One-dimensional Arrays, Declaration of One-dimensional Arrays, Initialization of One-dimensional Arrays, Two-dimensional Arrays, Declaration of Two-dimensional Arrays, Initialization of Two-dimensional Arrays, Simple Example programs- Sort, Matrix Multiplication, Transpose of a matrix. **Suggested list of programs for practice:** Write a C program 1. To display our College name twenty times on screen. 2. To display and add all even numbers from 1-100. 3. To find smallest / largest number from array elements. 4. To sort array elements in ascending / descending order. 5. To enter elements for 3X3 matrix and display them. 6. To calculate addition / subtraction of 2 dimensional matrix. 7. To calculate multiplication of 2 dimensional matrix. 8. To demonstrate output of standard library functions Strlen (), strcpy (), strcat (), strcmp (). 9. To calculate area of circle using function. 10. To calculate factorial of any given number using recursion. 11. To demonstrate call by reference, call by value To perform arithmetic functions on pointers.
II	**Introduction to MATLAB Programming:** Basics of MATLAB Programming, elementary features in a vector array, matrices, Eigen values and Eigen vectors, matrix operations, matrix operators, creating matrix arrangement, indexing array value, other operations, mathematical operations on array, array types, loops and execution of control, working with M-files, Scripts and functions, plotting and programming output, examples. Introduction to MATLAB Simulink, Simulink libraries
At least six (6) programs in C programming and four (4) programs in MATLAB.	

REFERENCES:

1.	Programming in C by Balgurusamy, Tata MGH
2.	E. Balaguruswamy, "Programming in ANSI C", 8th Edition, 2019, McGraw Hill Education, ISBN: 978-93-5316-513-0.
3.	Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", OXFORD Higher Education.

ELECTRICAL CIRCUITS LABORATORY

L	T	P		Course Code: EEPC213	
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 : PC	

RATIONALE:

The aim of this course is to implement, test, and troubleshoot Electric Circuit problems using hardware and design/model for verification using MATLAB Simulink to understand the concept better.

LEARNING OUTCOMES:

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

- Troubleshoot problems related to single phase A.C series circuits
- Troubleshoot problems related to single phase A.C parallel circuits
- Troubleshoot problems related to three phase circuits
- Use principles of circuit analysis to troubleshoot electric circuits.
- Apply network theorems to troubleshoot electric circuits

DETAILED COURSE CONTENTS

Sr. No.	List of experiments
1	Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.
2.	Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.
3.	Use voltmeter, ammeter, wattmeter, p.f meter to determine current, p.f., active, reactive and apparent power for given R-L-C parallel circuit with series connection of resistor and inductor in parallel with capacitor.
4.	Use variable frequency supply create resonance in given parallel R-L-C circuit or by using variable inductor or capacitor
5.	Use voltmeter, ammeter, wattmeter, p.f meter to determine line and phase quantities of voltage and current for balanced three phase star and delta connected load and calculate active, reactive, and apparent power. Draw phasor diagram.
6.	Use voltmeter, ammeter to determine current through the given branch of a electric network by applying mesh analysis.

7.	Use voltmeter, ammeter to determine current through the given branch of a electric network by applying node analysis.
8.	Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.
9.	Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem
10.	Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem
11.	Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.
12.	Use the node-voltage method to solve a circuit that containing resistors and independent and dependent current sources and voltage sources is connected between non-reference nodes using Simulink Simscape
13.	Use the mesh-current method to solve a circuit for an arbitrary network containing resistors and independent and dependent voltage and current sources using Simulink Simscape
14.	Using Simulink, determine A.C voltage and current response in given R, L, C circuit.
15.	Using Simulink, create resonance in given series R-L-C circuit
16.	Verify network theorems(Superposition, Thevenin's, Norton's, Maximum power transfer) using Simulink Simscape
Atleast ten (10) experiments – Eight(8) using hardware and two(2) using MATLAB Simulink Any three experiments from serial number 1 to 5 , any five from serial number 06 to 11, any two from sl no 12 to sl no 16.	

REFERENCES:

1.	Same as in EEPC203
2.	Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", OXFORD Higher Education.
3.	Dr. Shailendra Jain, "Modeling& Simulation using MATLAB – Simulink", Wiley – India.

ELECTRICAL & ELECTRONIC MEASUREMENTS LABORATORY

L	T	P		Course Code: EEPC215	
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 : PC	

RATIONALE:

The Electrical & Electronics Measurements Laboratory is very important in the field of Electrical Engineering. This subject deals with the technique of measuring voltage, current and wattage by the indicating type of instruments. The technique of measurement of Electrical power in single phase and three phase circuits will be studied in this laboratory. Measurement of energy and calibration and adjustment of energy meters will also be studied under this subject. Prior to above the working principle construction of all type of measuring instruments like indicating, integrating and recording type will also be studied in this course.

LEARNING OUTCOMES:

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

- Check the working of the electrical measuring instrument.
- Use different types of measuring instruments for measuring voltage and current.
- Use different types of measuring instruments for measuring electric power
- Use different types of measuring instruments for measuring electric energy.
- Use CRO for the Measurement of supply frequency in single-phase circuit

DETAILED COURSE CONTENTS

Sr. No.	Practical
1.	Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale
2.	Identify the components of PMMC and MI instruments.
3.	Extend range of ammeter and voltmeter by using (i) shunt and multiplier
4.	Use electro-dynamic watt-meter for measurement of power in a single phase circuit
5.	Use single three phase wattmeter for measurement of active and reactive power of three phase-balanced load.
6.	Use two wattmeters for measuring active power of three-phase balanced load.
7.	Calibrate single-phase electronic energy meter by direct loading.
8	Use Kelvin's double bridge for measurement of low resistance.
9.	Use voltmeter and ammeter method for measurement of medium resistance.

10.	Use Megger for insulation resistance measurements.
11.	Use earth tester for measurement of earth resistance.
12.	Use Tri-vector meter for measuring kW, kVAr and kVA of a power line.
13.	Study of Resolution and sensitivity of Digital Instrument
14.	Measure the unknown frequency and phase angle, using CRO by Lissajous figure.
Atleast ten (10) experiments to be performed by each student	

REFERENCES:

Same as EEPC205

DC MACHINES AND TRANSFORMERS LABORATORY

L	T	P		Course Code: EEPC217	
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 : PC**	

RATIONALE:

The applications of d.c. machine in modern industries are still in practice. The Electrical Engineering Technicians has to look after the installation, operation and control of electrical machines. So the practical knowledge of "Electrical Machine" is very essential in this regard. This subject covers d.c. Generators, d.c. motors, single phase transformers, three phase transformers and special purpose transformers. The aim of this course is to help the student to use electric motors and transformers.

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LEARNING OUTCOMES:

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

- Check the working of the electrical dc machines and transformers
- Maintain different types of DC generators.
- Maintain different types of DC motors.
- Maintain single-phase transformer.
- Maintain three phase transformers.
- Maintain different types of special purpose transformers used in different applications.

DETAILED COURSE CONTENTS

Sr. No.	List of experiments /Practical
1.	Dismantle a DC machine.
2.	Reverse the direction of rotation of the DC shunt motor.
3.	Control the speed of DC shunt motor by field flux and armature voltage control methods.
4.	Perform the brake test on DC series motor.
5.	Check the functioning of single phase transformer
6.	Determine regulation and efficiency of single phase transformer by direct loading
7.	Perform open circuit and short circuit test on single phase transformer to determine equivalent circuit constants, voltage regulation and efficiency
8.	Perform parallel operation of two single-phase transformers to determine the load current sharing.

9.	Perform polarity test on a single-phase transformer whose polarity markings are masked.
10.	Perform phasing out test on a three-phase transformer whose phase markings are masked.
11.	Connect the autotransformer in step-up and step-down modes noting the input/output readings.
12.	Test the pulse transformer.
Atleast ten (10) experiments to be performed by each student.	

REFERENCES:

1.	From Sunlight to Electricity: a practical handbook on solar photovoltaic application by Suneel Deambi, TERI, New Delhi.
2.	Renewable Energy Systems, Pearson Education by David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, New Delhi.
3.	Wind Power Technologies by Sthuthi Rachel, Joshua Earnest, PHI Learning, New Delhi.
4.	Biogas Technology: Towards Sustainable Development by Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; TERI, New Delhi.
5.	Wind Energy Basics by Paul, Gipe, Chelsea Green Publishing Co.
6.	Renewable Energy Sources and Emerging Technologies by D.P. Kothari, PHI Learning, New Delhi.
7.	Wind Electrical Systems installation by S.N. Bhadra, D. Kastha, S, Banerjee, Oxford University Press, New Delhi.
8.	Energy Technology by O.P. Gupta, Khanna Publishing House, New Delhi.

SUMMER INTERNSHIP – I

L	T	P		Course Code: SI201	
0	0	0			
Total Contact Hours				Assessment	
Practical		0	Total Marks: 50	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		: Nil			
Credits		2		Category of Course : SI	

Duration: 3-4 weeks during summer vacation after 2nd Semester.

RATIONALE

Summer Internship - I is to offer a structured and practical learning experience that prepares individuals for their future careers, helps them make informed career choices, and equips them with the skills and knowledge necessary to succeed in their chosen field. This course provides opportunities to students for hands-on industry experience.

LEARNING OUTCOMES

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

- Apply theoretical knowledge gained in their academic coursework to real-world situations.
- Enhance specific skills relevant to their field.
- Gain hands-on experience in a professional network by interacting with mentors and industry professionals.
- Manage time effectively.
- Clarify career goals.

DETAILED COURSE CONTENTS

SUGGESTED ACTIVITIES:

I Orientation:

- Introduction to the organization's mission, values, and culture.
- Familiarization with workplace policies, procedures, and safety guidelines.
- Orientation to the team and organizational structure.

II Project-Based Learning:

- Description of the main project or tasks the intern will be working on during the internship.
- Detailed project goals and objectives.
- Training and guidance on project-specific tools, technologies, or methodologies.

III Technical and Skill Development:

- Training sessions or workshops to enhance technical skills relevant to the internship role (e.g., programming languages, software tools, laboratory techniques).
- Soft skills development, including communication, teamwork, problem solving, and time management

IV Mentorship and Supervision:

- Regular meetings with a designated mentor or supervisor for guidance, feedback, and support.
- Mentorship objectives and expectations.

V Professional Development:

- Sessions on professional etiquette, networking, and building a personal brand
- Resume writing and interview preparation workshops.

VI Industry and Field-Specific Knowledge:

- Lectures, seminars, or presentations on industry trends, best practices, and emerging technologies.
- Guest speakers from the field to share insights and experiences.

VII Reporting and Documentation:

- Training on how to document project progress, results, and findings.
- Practice in creating reports, presentations, or other deliverables.

VIII Ethics and Professionalism:

- Discussions on ethical considerations within the field.
- Scenarios and case studies related to ethical decision-making

IX Feedback and Evaluation:

- Regular performance evaluations and feedback sessions.
- Self-assessment and goal-setting exercises.

X Networking and Industry Exposure:

- Opportunities to attend industry conferences, webinars, or networking events.
- Encouragement to connect with professionals in the field.

NOTE

As per AICTE guidelines, in Summer Internship-I, students are required to be involved in Inter/ Intra Institutional Activities viz;

- Training with higher Institutions;
- Soft skill training organized by Training and Placement Cell of the respective institutions;
- contribution at incubation/ innovation /entrepreneurship cell of the institute;
- participation in conferences/ workshops/ competitions etc.;
- Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop;
- Working for consultancy/ research project within the institutes and
- Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.

Suggested Online Link:

Web Links:

1.https://www.youtube.com/watch?v=LZP1StpYEPM

2.http://nptel.ac.in/courses/12110600/