Faculty of Engineering and Technology

Radha Govind University

Chandausi, Sambhal (U.P.)

Evaluation Scheme & Syllabus for

Department of Electrical Engg.

DIPLOMA –ELECTRICAL ENGINEERING

II Year (III & IV Semester)

(Effective from session _____)

ELECTRICAL ENGG. STUDY AND EVALUATION SCHEME

2nd Year, 3RD Semester

SUBJEC CODE	SUBJECT SNAME	STUDY SCHEM E Periods /Wee k			Credits	MARKSINEVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMEN T			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
DEE 301	BASICS OF POWER GENERATION SYSTEM	3	-	-	3	30	-	30	70	-	70	100
DEE 302	ELECTRICAL MACHINE-I	4	-	-	4	30	-	30	70	-	70	100
DEE 303	ELECTRICAL CIRCUITS	1	-	4	3	30	-	30	70	-	70	100
DEE 304	ELECTRICAL AND ELECTRONICS MEASUREMENTS	2	-	4	4	30	-	30	70	-	70	100
DEE 305	ELECTIVE-I	2	-	-	2	30	-	30	70	-	70	100
DEE 306	ELECTRICAL MACHINE-I LAB	-	-	4	2	-	25	25	-	25	25	50
DEE 307	ELECTRICAL CIRCUIT LAB	-	-	4	2	-	25	25	-	25	25	50
DEE 308	ELECTRICAL & ELECTRONICS MEASUREMENTS LAB	-	-	4	2	-	25	25	-	25	25	50
Total					22	150	75	225	350	75	425	650

For pass the candidate is required to obtain 40% marks in each paper and 50% marks in aggregate.

DEE 305 Elective-I :-

1. ENGINEERING ECONOMICS & ACCOUNTANCY
2. DISASTER MANAGEMENT

ELECTRICAL ENGG. STUDY AND EVALUATION SCHEME

2nd Year, 4th Semester

SUBJEC CODE	SUBJECT SNAME	STUDY SCHEM E Periods /Wee k			Credits	MARKSINEVALUATION SCHEME						Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMEN T			
		L	T	P		Th	Pr	Tot	Th	Pr	Tot	
DEE 401	ELECTRICAL POWER TRANSMISSION & DISTRIBUTION	3	-	-	3	30	-	30	70	-	70	100
DEE 402	ELECTRICAL MACHINE-II	3	-	-	3	30	-	30	70	-	70	100
DEE 403	FUNDAMENTS OF POWER ELECTRONICS	2	-	4	4	30	-	30	70	-	70	100
DEE 404	INDUSTRIAL AUTOMATION & CONTROL	1	-	4	3	30	-	30	70	-	70	100
DEE 405	Elective-II	3	-	-	3	30	-	30	70	-	70	100
DEE 406	ELECTRICAL MACHINE-II LAB	-	-	4	2	-	25	25	-	25	25	50
DEE 407	FUNDAMENTS OF POWER ELECTRONICS LAB	-	-	4	2	-	25	25	-	25	25	50
DEE 408	INDUSTRIAL AUTOMATION & CONTROL LAB	-	-	4	2	-	25	25	-	25	25	50
Total					22	150	75	225	350	75	425	650

For pass the candidate is required to obtain 40% marks in each paper and 50% marks in aggregate.

DEE 405 Elective-II :-

1. RENEWABLE ENERGY POWER PLANTS

2. BIOMASS AND MICRO-HYDRO POWER PLANTS

Industrial training (Summer Internship) of 4-6 weeks duration to be organized after 4th semester exam.

DEE 301

BASICS OF POWER GENERATION SYSTEM

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3	-	-

COURSE OBJECTIVES:

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

• Maintain the efficient operation of various electric power generating plants.

COURSE OUTCOMES (CO):

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

CO1 : Explain the schematic arrangement, working principles, and safety practices of Thermal (Coal, Gas, Diesel) and Nuclear power plants.

CO2 : Interpret the hydrology, site selection, and operation of Hydro-electric power plants and the principles of MHD generation.

CO3 : Describe the construction, working, and layout of Solar (CSP & PV) and Wind power generation systems.

CO4 : Discuss the technologies and significance of non-conventional energy sources like Biomass, Geothermal, Tidal, and Fuel Cells.

CO5 : Analyze power generation economics by calculating load factors, diversity factors, and selecting appropriate generator unit sizes.

COURSE CONTENTS

Unit – I: Power Plants: Coal, Gas, Diesel and Nuclear-based (08 Periods)

Schematic arrangement of power plant (coal-based, gas-based, diesel-based, nuclear-based) Functions of the various types of power plants and their major auxiliaries. Safe working Practices of various power plants: coal-based, gas-based, diesel-based, nuclear-based.

Unit – II: Large Hydro Power Plants and MHD (08 Periods)

Hydrology, stream flow, hydrograph, flow duration curves. Types of hydroelectric plants and their fields of use, capacity calculations for hydropower, Dams, head water control, penstocks, water turbines, specific speeds, turbine governors. Hydro plant auxiliaries, plant layout. Concepts and principles of Magneto Hydro Dynamic (MHD) generation.

Unit – III: Solar and Wind Power Plants (08 Periods)

Solar Power Technology

a. Concentrated Solar Power (CSP) plants, construction and working of: Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors

b. Solar Photovoltaic (PV) power plant: layout, construction, working. Wind power density in watts per square meter, Horizontal and vertical axis large wind power plant, Geared wind power plant, Direct-drive wind power plant.

Unit – IV: Other Generating Stations (08 Periods)

Biomass: Biomass conversion technologies, methods for obtaining energy from biomass. Geothermal and Tidal Energy: Geothermal sources and its significance, geo-thermal power plant – dry steam, flash steam, and binary cycle, Tidal energy and its significance, Different types of tidal power plants: single basin, double basin. Fuel Cells: Concept, types and principles of fuel cells.

Unit – V: Economics of Power Generation and Interconnected Power System (10 Periods)

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.

Cost of generation: Average demand, maximum demand, demand factor, plant capacity factor, plant use factor, diversity factor, load factor and plant load factor.

Choice of size and number of generator units, combined operation of power station. Smart Grid.

INSTRUCTIONAL STRATEGY

Electric Generation Systems being a core subject of electrical diploma curriculum, where a student will deal with various types of Electric Generations which are employed in industry and power stations etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these electric generation systems and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests.

MEANS OF ASSESSMENT

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

− Actual laboratory and practical work, model/proto type making and viva- voce.

RECOMMENDED BOOKS:

1. Nag. P. K. Power Plant Engineering, McGraw Hill, New Delhi, ISBN: 978-9339204044.

2. Tanmoy Deb, Electrical Power Generation, Khanna Publishing House, Delhi (Ed. 2018).

3. Gupta, B.R., Generation of Electrical Energy, S. Chand & Co. New Delhi,.

4. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9.

5. Solanki, Chetan Singh, – Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI Learning, New Delhi, ISBN: 9788120351110.

6. Hau, Erich, Wind Turbines, Springer-Verlag, Berlin Heidelberg, Germany, ISBN:978-3-642-27150-2.

7. Gipe, Paul, Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304.

8. Wizelius, Tore; Earnest, Joshua – Wind Power Plants and Project Development, PHI.

9. Gupta, J.B. A Course in Electrical Power– S. K Kataria and Sons, New Delhi. 2014,

10. Soni, Gupta, Bhatnagar, A Course in Electrical Power. – Dhanpat rai and Sons

11. System, S.Chand & Co. New Delhi, 2005, ISBN: 9788121924962.

12. Ashish Sahu, Pooja Yadav, Power Plant Engineering, Asian Publishers, Muzaffarnagar. ISBN:978-93-55021-025-3.

DEE 302

ELECTRICAL MACHINE-I

L	T	P
4	-	-

COURSE OBJECTIVES:

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

•Maintain electric motors and transformers.

COURSE OUTCOMES(CO):

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

CO1 : Understand the significance and operation of DC Generator.

CO2 : Understand the significance and operation of DC Motor.

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

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

CO5 : Apply maintenance strategies for electrical equipment.

COURSE CONTENTS

Unit – I: DC Generators (10 Periods)

Classification of insulating materials according to temperature, Insulating materials used in DC machines and transformers (Emery paper, mica, varnish, sleeves, cotton tape, paper and oil).

DC generator: construction, parts, materials and their functions.

Principle of operation of DC generator: Fleming's right-hand rule, schematic diagrams, e.m.f. equation of generator, armature reaction, commutation.

Applications of DC generators. Importance of DC generators in various industries.

Unit – II: D.C. Motors (10 Periods)

DC motor: Types of DC motors. Fleming's left-hand rule, Principle of operation of Back e.m.f. and its significance, Voltage equation of DC motor.

Torque and Speed; Armature torque, Shaft torque, BHP, Brake test, losses, efficiency.

DC motor starters: Two Point, Three-point and Four Point starters.

Speed control of DC shunt and series motor: Flux and Armature control.

Brushless DC Motor: Construction and working.

Unit– III: Single Phase Transformers (12 Periods)

Types of transformers: Shell type and core type;

Construction: Parts and functions,

Transformer: Principle of operation, EMF equation of transformer: Derivation, Voltage transformation ratio, Significance of transformer ratings

Transformer No-load and on-load phasor diagram, Leakage reactance,

Equivalent circuit of transformer: Equivalent resistance and reactance.

Voltage regulation and Efficiency: Direct loading, OC/SC method, All day efficiency.

Polarity tests on single phase transformers.

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

Three Phase Transformers: Construction, cooling, three-phase transformers connections, three-phase to two phase conversion (Scott Connection), parallel operation of three phase transformer. Comparison between Bank of three single phase transformers & Single unit of three phase transformer

Transformer accessories: Conservator, Breather, Explosion vent, Buchholz relay –ON load and OFF load tap changer.

Distribution and Power transformers. Auto Transformer and its applications

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

Importance of Maintenance : Preventive and Breakdown Maintenance .

Causes of Sparking in Commutator, Defects in Commutator and Remedies, Resurfacing of Commutator and Brushes , Defects in DC Armature winding

Maintenance of Transformer Oil , Transformer oil tester , Acidity test, BDV test

Earthing : Measurement of earth resistance.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

− Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva voce.

RECOMMENDED BOOKS:

1. G.C. Garg & P.S. Bimbhra, Electrical Machines, Vol-I, II, Khanna Book Publishing House

(ISBN: 978-9386173-447, 978-93-86173-607), New Delhi.

2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education, New Delhi, ISBN: 9780070593572.

3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN:9780070699670

4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN: 9789332902855.

5. Mehta, V. K. and Mehta, Rohit, Principles of Electrical Machines, S. Chand and Co. Ltd., New Delhi, ISBN: 9788121930888.

6. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S. Chand and Co. Ltd., New Delhi, ISBN: 9788121924375.

7. Bandyopadhyay, M. N., Electrical Machines Theory and Practice, PHI Learning Pvt. Ltd., New Delhi, ISBN: 9788120329973.

8. Murugesh Kumar, K., DC Machines and Transformers, ISBN: 9788125916055.

ELECTRICAL MACHINE-I LAB

LIST OF PRACTICALS (To perform any Ten practical)

1. Reverse the direction of rotation of the DC shunt motor.

2. Perform brake test on DC shunt motor.

3. Control the speed of DC shunt motor by different methods.

4. Control the speed of DC series motor by different methods.

5. Perform the brake test of DC series motor.

6. No load and Full Load Characteristics of Self Excited DC Shunt Generator.

7. Load Characteristics of Self Excited DC Series Generator.

8. Determine regulation and efficiency of single-phase transformer by direct loading.

9. Perform open circuit and short circuit test on single phase transformer to determine voltage regulation and efficiency.

10. Finding the Equivalent Circuit Constants of Single-Phase Transformer by conducting O.C and S.C Tests.

11. Perform parallel operation of two single phase transformers to determine the load current sharing, apparent and real power load sharing.

12. Perform parallel operation of two single phase transformers and determine the apparent and real power load sharing.

13. Perform polarity test on a single-phase transformer whose polarity markings are masked.

14. Connect the autotransformer in step-up and step-down modes noting the input/output readings.

15. Breakdown Test to determine the Dielectric Strength of Transformer Oil.

DEE 303 ELECTRICAL CIRCUITS

COURSE OBJECTIVES:

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

L	T	P
1	-	4

• Maintain electrical systems applying AC and DC circuit fundamentals.

COURSE OUTCOMES (CO):

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

CO1: Analyse the behaviour of R, L, C elements in single-phase AC series circuits.

CO2: Interpret the performance of R-L, R-C, and R-L-C parallel AC circuits.

CO3: Explain the generation and configuration of three-phase systems for star and delta connections.

CO4: Apply mesh and nodal analysis techniques to simplify and solve electrical circuits.

CO5: Use fundamental network theorems to analyse electrical circuit performance.

COURSE CONTENTS

Unit – I Single Phase A.C Series Circuits (03 Periods)

Sinusoidal quantities : Instantaneous, peak, average and effective values , Form Factor , Peak factor R, L, C circuit elements its voltage and current response.

R-L, R-C, R-L-C combination of A.C series circuit, impedance, reactance, impedance triangle, active power, reactive power, apparent power, power triangle and phasor diagram, Power factor.

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

Unit – II Single Phase A.C Parallel Circuits (03 Periods)

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

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

Unit– III Three Phase Circuits (03 Periods)

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

Types of three-phase connections, Relation between phase and line quantities in three phase star and delta system. Balanced and unbalanced load, three phase power, active, reactive and apparent power in star and delta system.

Unit– IV Network Reduction and Principles of Circuit Analysis (03 Periods)

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

Unit – V: Network Theorems (02 Periods)

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

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

− Actual laboratory and practical work, model/prototype making, assembly and disassembly

exercises and viva voce.

RECOMMENDED BOOKS:

1. Ashfaq Husain, Networks & Systems, Khanna Book Publishing, New Delhi.

2. Gupta, B. R; Singhal, Vandana; Fundamentals of Electrical Network, S. Chand and Co., New Delhi, ISBN: 978-81-219-2318-7

3. Saxena, S.B Lal; Dasgupta, K; Fundamentals of Electrical Engineering, Cambridge University Press Pvt. Ltd., New Delhi, ISBN: 978-11-0746-435-3

4. Theraja, B. L.: Theraja, A. K, A Text Book of Electrical Technology Vol-I, S. Chand & Co. Ramnagar, New Delhi, ISBN: 9788121924405

5. Sudhakar, A.; Shyammohan, S. Palli; Circuit and network, McGraw Hill Education, New Delhi, ISBN: 978-93-3921-960-4

6. Bell, David A., Electric Circuits, Oxford University Press New Delhi, ISBN: 978-01-954 25246

7. Boylested, R.L., Introductory circuit Analysis, Wheeler, New Delhi, ISBN: 978-00-231-31615

8. Mittle, V.N.; Mittle, Arvind; Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 978-00-705-9357-2.

ELECTRICAL CIRCUITS LAB

Practicals: -

1. Use dual trace oscilloscope to determine A.C voltage and current response in given R, L, C circuit.

2. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L series circuit. Draw phasor diagram.

3. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C series circuit. Draw phasor diagram.

4. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C series circuit. Draw phasor diagram.

5. Use variable frequency supply to create resonance in given series R-L-C circuit or by using variable inductor or variable capacitor.

6. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L Parallel circuit. Draw phasor diagram.

7. Use voltmeter, ammeter to determine active, reactive and apparent power consumed in given R-C Parallel circuit. Draw phasor diagram.

8. Use voltmeter, ammeter, wattmeter to determine active, reactive and apparent power consumed in given R-L-C Parallel circuit. Draw phasor diagram.

9. Use variable frequency supply to create resonance in given series R-L-C Parallel or by using variable inductor or variable capacitor.

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

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

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

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

14. Use voltmeter, ammeter to determine current through the given branch and voltage across the given element of circuit by applying superposition theorem.

15. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Thevenin's theorem

16. Use voltmeter, ammeter to determine equivalent circuit parameter in a given circuit by applying Norton's theorem

17. Use voltmeter, ammeter to determine load resistance for maximum power transfer for a given circuit by applying maximum power transfer theorem.

DEE 304 ELECTRICAL AND ELECTRONICS MEASUREMENTS

COURSE OBJECTIVES:

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

L	T	P
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• Use relevant measuring instrument in different electrical applications.

COURSE OUTCOMES (CO):

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

CO1: Explain the significance of measurement systems.

CO2: Demonstrate the working principles and applications of MI and MC instruments.

CO3: Analyse the construction, operation, and range extension techniques.

CO4: Describe the working principles and features of electronic energy meters.

CO5: Apply appropriate instruments and bridge methods to measure electrical parameters.

COURSE CONTENTS

Unit – I: Fundamentals of Measurements (06 Periods)

Measurement: Significance, units, fundamental quantities and standards Classification of Instrument Systems, Classifications of Analog Instruments (Indicating, Recording and Integrating) Essential requirements of an indicating instruments: deflecting, controlling, damping torque Static and dynamic characteristics, types of errors.

Calibration: need and procedure

Unit – II: Measurement of voltage and current (06 Periods)

Concept and working principles of moving iron (MI) and moving coil (MC) instruments.

DC Ammeter: Basic, Multi range, Universal shunt.

DC Voltmeter: Basic, Multi-range, concept of loading effect and sensitivity.

AC voltmeter: Rectifier type (half wave and full wave)

CT and PT: working principle and applications.

Clamp-on meter.

Unit – III: Measurement of Electric Power (06 Periods)

Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter, their construction, working, salient features, merits and demerits Dynamometer type wattmeter: Construction, working, merits and demerits.

Range extension: Multiplying factor and extension of range using CT and PT. Errors and compensations.

Active and reactive power measurement: One, two and three wattmeter method. Effect of Power factor on wattmeter reading in two wattmeter method.

Maximum Demand indicator: construction and working principle. Digital wattmeter.

Unit – IV: Measurement of Electric Energy (04 Periods)

Single and three phase electronic energy meter: Constructional features and working principle. Errors and their compensations. Calibration of single-phase electronic energy meter using direct loading. Digital energy meter.

Unit – V: Circuit Parameter Measurement through CRO and Other Meters (06 Periods)

Measurement of resistance: (a) Low resistance: Kelvin's double bridge, (b) Medium Resistance: Voltmeter and ammeter method, and (c) High resistance:

Megger and Ohm meter: Series and shunt Measurement of inductance using Anderson bridge (no derivation and phasor diagram) Measurement of capacitance using Schering bridge (no derivation and phasor diagram) Measurement of voltage/ amplitude/ time period/ frequency/ phase angle delay line, through CRO. 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.

INSTRUCTIONAL STRATEGY -

After making the students familiar with measuring instruments, they should be made conceptually clear about the constructional features and make them confident in making connection of various measuring instruments. Teacher should demonstrate the application of each measuring instrument in laboratory and encourage students to use them independently.

MEANS OF ASSESSMENT

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

− Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva voce.

RECOMMENDED BOOKS:

1. Theraja B. L., Theraja A. K., A Text Book of Electrical Technology Vol-I(Basic Electrical Engg.), S.Chand and Co. New Delhi, ISBN: 9788121924405.

2. Mittle V. N., Basic Electrical Engineering, McGraw-Hill New Delhi, ISBN: 978-0-07-0088572- 5,

3. Edward Hughes, Electrical Technology, Pearson Education, New Delhi, ISBN-13: 978- 0582405196.

4. Rajput R.K., Electrical and Electronic Measurement and Instrumentation, S.Chand and Co. New Delhi, ISBN : 9789385676017.

5. Sawhney A.K., Electrical and Electronics Measurements and Instrumentation., Dhanpai Rai and Sons, New Delhi, ISBN: 9780000279744.

6. Suryanarayna N.V., Electrical Measurements and Measuring Instruments, S.Chand and Co. New Delhi , ISBN :8121920116.

7. Dr. T.D. Bisht, Ashish Sahu, Pooja Yadav, Electrical Instrumentation & Measurement, Asian Publishers, Muzaffarnagar. ISBN: 978-93-91541-29-3.

ELECTRICAL AND ELECTRONICS MEASUREMENTS LAB

Practical's:-

1. Identify measuring instruments on the basis of symbols on dial, type, accuracy, class position and scale.
2. Measure AC and DC quantities in a working circuit.
3. Use Voltmeter, Ammeter and Wattmeter for different loads to conduct an experiment to measure voltage, current and power respectively in single phase a.c circuit.
4. Use Clamp-On Meter to conduct an experiment to measure current in a.c circuit.
5. Use single wattmeter for measurement of active power and power factor of single-phase circuit.
6. Use two wattmeter's for measuring active power of three-phase balanced load.
7. Extend range of ammeter and voltmeter by using (i) shunt and multiplier (ii) CT and PT.
8. Calibrate single phase energy meter by direct loading.
9. Use digital multi-meter for measurement of AC/DC current, AC/DC voltage.
10. Use Kelvin's double bridge for measurement of low resistance.
11. Use voltmeter and ammeter method for measurement of medium resistance.
12. Use Megger for insulation resistance measurements.
13. Use earth tester for measurement of earth resistance.
14. Use CRO for the Measurement of supply frequency in single-phase circuit.
15. Use Tri-vector meter for measuring kW, kVAr and kVA of a power line.

DEE- 305 ELECTIVE –I

(E-I) ENGINEERING ECONOMICS & ACCOUNTANCY

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COURSE OBJECTIVES:

To acquire knowledge of basic economics to facilitate the process of economic decision making.

• To acquire knowledge on basic financial management aspects.

• To develop the basic skills to analyze financial statements.

COURSE OUTCOMES (CO) :

CO1: Explain the fundamental concepts of managerial economics, firm objectives, and the decision-making process in an engineering context.

CO2: Analyze market dynamics by applying the concepts of demand and supply elasticity and forecasting techniques.

CO3: Apply production functions and cost analysis techniques to optimize resources and estimate short run and long-run costs.

CO4: Determine appropriate pricing strategies based on market structures (perfect/imperfect competition) and government regulations.

CO5: Interpret financial statements (Balance Sheet, P&L) and evaluate investment risks/returns using Ratio Analysis, NPV, and IRR.

COURSE CONTENTS

Unit – I: Introduction (04 Periods)

Managerial Economics; Relationship with other disciplines; Firms: Types, objectives and goals; Managerial decisions; Decision analysis.

Unit – II: Demand & Supply Analysis (05 Periods)

Demand; Types of demand; Determinants of demand; Demand function; Demand elasticity; Demand forecasting; Supply; Determinants of supply; Supply function; Supply elasticity.

Unit – III: Production and Cost Analysis (06 Periods)

Production function; Returns to scale; Production optimization; Least cost input; Isoquants; Managerial uses of production function; Cost Concepts; Cost function; Types of Cost; Determinants of cost; Short run and Long run cost curves; Cost Output Decision; Estimation of Cost

Unit – IV: Pricing (05 Periods)

Determinants of Price; Pricing under different objectives and different market structures; Price discrimination; Pricing methods in practice; Role of Government in pricing control.

Unit – V: Financial Accounting (Elementary Treatment) (08 Periods)

Balance sheet and related concepts; Profit & Loss Statement and related concepts; Financial Ratio Analysis; Cash flow analysis; Funds flow analysis; Comparative financial statements; Analysis & Interpretation of financial statements; Investments; Risks and return evaluation of investment decision; Average rate of return; Payback Period; Net Present Value; Internal rate of return.

RECOMMENDED BOOKS:

1. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi, 2018

2. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson Southwestern, 10th Edition, 2005.

3. Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.

4. Samuelson. Paul A and Nordhaus W.D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.

5. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007.

(E-I) DISASTER MANAGEMENT

COURSE OBJECTIVES:

Following are the objectives of this course:

• To learn about various types of natural and man-made disasters.

• To know pre- and post-disaster management for some of the disasters.

• To know about various information and organizations in disaster management in India.

• To get exposed to technological tools and their role in disaster management.

COURSE OUTCOMES(CO):

After completing this course, student will be:

CO1: Acquainted with fundamental concepts of disaster, hazard, vulnerability, risk, and capacity, and explain their inter-relationships.

CO2 : Classify various types of disasters (Geological, Hydro-meteorological, Biological, Manmade) and analyze their causes, trends, and consequences.

CO3 : Apply the Disaster Management Cycle (Pre, During, Post) and global frameworks (Hyogo, IDNDR) to plan for risk assessment and mitigation.

CO4 : Familiarised with institutional and legal mechanism of Disaster Management in India, including the DM Act 2005 and the role of various agencies.

CO5: Able to select scientific tools (GIS, RS, GPS) and engineering practices (structural/nonstructural mitigation) for disaster preparedness and safe construction.

COURSE CONTENTS

Unit – I: Understanding Disaster (02 Periods)

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

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters (05 Periods)

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit - III: Disaster Management Cycle and Framework (08 Periods)

Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness. During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

Unit – IV: Disaster Management in India (05 Periods)

Disaster Profile of India – Mega Disasters of India and Lessons Learnt. Disaster Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies 457 Open Elective Courses.

Unit – V: Applications of Science and Technology for Disaster Management (08 Periods)

Geo-informatics in Disaster Management (RS, GIS, GPS and RS). Disaster Communication System (Early Warning and Its Dissemination). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India **.**

RECOMMENDED BOOKS:

1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management.

2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi.

3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi.

4. Alexander, David, Natural Disasters, Kluwer Academic London.

5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation.

6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

DEE 401

ELECTRICAL POWER TRANSMISSION & DISTRIBUTION

L	T	P
3	-	-

COURSE OBJECTIVES

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

• Maintain the proper functioning of the electrical transmission and distribution systems.

COURSE OUTCOMES (CO)

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

CO1: Interpret the layout of electrical supply systems, standard voltage levels, and compare AC vs. DC transmission.

CO2: Analyze mechanical sag and electrical parameters (Regulation, Efficiency) of AC transmission lines and phenomena like Corona and Skin effect.

CO3: Discuss modern transmission technologies including HVDC link configurations and FACTS controllers (STATCOM, UPFC).

CO4: Determine the efficiency of insulator strings and identify constructional details and fault location methods for underground cables.

CO5: Illustrate the layout of Substations (Air Insulated & GIS) and classify various AC distribution schemes.

COURSE CONTENT

Unit – I: Basics of Transmission and Distribution (06 Periods)

Single line diagrams of the electric supply transmission and distribution systems. Standard voltage level used in India. Classification of Transmission lines. Characteristics of high voltage for both AC and DC power transmission.

Unit – II: AC Transmission (10 Periods)

Typical Layout of A.C. Power supply scheme - Elements of a Transmission Line Over Head Line, Conductor materials and their properties , Line supports and their properties - Types of supports and their applications, Sag in overhead lines, Calculation of Sag - When the supports are at equal and unequal levels - Simple Numerical Problems, Constants of a Transmission line, Transposition of Transmission lines , Skin Effect , Ferranti Effect, Corona Formation, Factors affecting Corona, Classification of O.H. Transmission lines - Voltage regulation and Transmission Efficiency (No Numerical Problems). Concept of power factor, effects of low power factor, methods of improving low power factor: static capacitor, synchronous condenser, SVC.

Unit – III: Hvdc Transmission & Facts (08 Periods)

H.V.D.C Transmission: Layout Scheme , D.C Link configurations - Mono polar, Bipolar and Homo polar links HVDC Convertor Station (Schematic diagram only) – Integration of HVDC & Renewable energy

into existing AC grids HVDC Locations in India. FACTS: Definition, Need for FACTS controllers, Types of FACTS controllers, SVS, STATCOM, UPFC (Block diagram explanation only).

Unit – IV: Line Insulators and Underground Cables (10 Periods)

Natural insulating materials, properties and their applications-mica, asbestos, ceramic materials, glass, cotton, silk, jute, paper(dry and impregnated), rubber, bitumen, gaseous materials(air, hydrogen, nitrogen, SF6). Line Insulators: Properties of Insulators , Materials , Types , Causes of failure of Insulators, Testing of Insulators Potential Distribution over suspension Insulator string, String Efficiency - Methods of improving string Efficiency – Simple Problems. Underground Cables: Construction of a three core cable, Classification of cables, Cables for three phase service , Construction of Belted cable, Screened cable, Pressure cables, Laying of underground cables and cable jointing, Faults in cables, fault localization using Blavier and Loop tests.

Unit – V: Sub-Stations & Distribution Systems (08 Periods)

Sub-Stations: Classification, advantages, disadvantages and applications. Single Line diagram (layout) of 33/11KV and 11KV/400V sub-station, functions of various auxiliaries and equipments associated with it. Gas Insulated Substation (GIS) Distribution system - Requirements and parts of Distribution system, Classification Comparison of different distribution systems (A.C and D.C, Overhead & Underground) A.C Distribution - Types - Connection schemes of AC Distribution system.

INSTRUCTIONAL STRATEGY

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

MEANS OF ASSESSMENT

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

– Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce.

RECOMMENDED BOOKS:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355)

2. Mehta, V.K., Principles of Power System, S. Chand and Co. New Delhi, ISBN: 9788121924962

3. Soni; Gupta; Bhatnagar, A Course in Electrical Power, Dhanpat Rai and Sons New Delhi, ISBN: 9788177000207

4. Gupta, J.B., A Course in Power Systems, S.K. Kataria and sons, New Delhi, ISBN: 9788188458523

5. Theraja, B.L.; Theraja, A.K., A Textbook of Electrical Technology Vol. III, S. Chand and Co. New Delhi, ISBN: 9788121924900

6. Uppal, S.L., A Course in Electrical Power, S.K. Khanna Publisher New Delhi, ISBN: 9788174092380

7. Sivanagaraju S.; Satyanarayana S., Electrical Power Transmission and Distribution, Pearson Education, New Delhi, ISBN: 9788131707913

8. Ned Mohan, Electrical Power System: A First Course, Wiley India Pvt. Ltd. New Delhi, ISBN:9788126541959

9. Gupta, B.R., Power System Analysis and Design, S. Chand and Co. New Delhi, ISBN: 9788121922388

10. Kamraju, V., Electrical Power Distribution System, Tata McGraw-Hill, New Delhi, ISBN:9780070151413

DEE 402

ELECTRICAL MACHINE-II

L	T	P
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COURSE OBJECTIVES

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

• Maintain Induction, Synchronous and Special Electric Machines (SEM) used in different applications.

COURSE OUTCOMES (co)

COURSE OUTCOMES (CO): On successful completion of this course, the student will be able to
CO1 : Understand rotating magnetic fields, induction motor principles, construction, characteristics, starting and speed control methods.
CO2: Examine single-phase motor types, maintenance practices.
CO3 : Understand alternator principles, construction, types, EMF equation, and applications and Achieve expertise in voltage regulation, testing, load analysis, and synchronization of alternator.
CO4 : Understand synchronous motor principles, behaviours and its applications
CO5 :, Understand construction of special Electrical Machines and its applications

COURSE CONTENT

Unit – I: Three Phase Induction Motor (10 Periods)

Working principle: production of rotating magnetic field, Synchronous speed, rotor speed and slip. Locking of rotor and stator fields. Constructional details of 3 phase induction motors: Squirrel cage induction motor and Slip ring induction motor. Rotor quantities: frequency, induced emf, power factor at starting and running condition.

Characteristics of torque versus slip (speed), Torques: starting, full load and maximum with relations among them. Relationship between rotor copper losses, slip and rotor input power (Power flow diagram)

Starters: need and types; stator resistance, auto transformer, star delta, rotor resistance and soft starters.

Speed control methods: stator voltage, pole changing, rotor resistance and VVVF.

Motor selection for different applications as per the load torque-speed requirements.

Unit – II: Single phase induction motors (08 Periods)

Double field revolving theory, principle of making these motors self-start.

Construction, working and Torque-speed characteristics: Resistance start induction run, capacitor start induction run, capacitor start capacitor run, shaded pole, repulsion type, series motor, universal motor, hysteresis motor.

Motor selection for different applications as per the load torque-speed requirements.

Unit– III: Three phase Alternators (10 Periods)

Principle of working, moving and stationary armatures.

Constructional details: parts and their functions, Windings: Single and Double layer.

Equivalent circuit diagram, E.M.F. equation of an Alternator with numerical by considering short pitch factor and distribution factor.

Necessary conditions of parallel operation of alternators.

Armature reaction at various power factors and synchronous impedance.

Voltage regulation: direct loading and synchronous impedance methods.

Operation of synchronous machine as a motor

Unit– IV: Synchronous Motors (08 Periods)

Principle of working , Torques: starting torque, running torque, pull in torque, pull out torque.

Synchronous motor on load with constant excitation (numerical), effect of excitation at constant load (numerical).

Concept of synchronous condenser

V-Curves and Inverted V-Curves. Hunting and Phase swinging.

Methods of Starting of Synchronous Motor.

Losses in synchronous motors and efficiency (no numerical). Applications areas

Unit– V: Special Electric Machines (06 Periods)

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

INSTRUCTIONAL STRATEGY

Induction, Synchronous and Special Electric Machines (SEM) being a core subject of electrical diploma curriculum, where a student will deal with various types of induction motors, Alternators, Synchronous Motors and Special Electric Machines which are employed in industry, power stations, domestic and commercial appliances etc. After studying this subject, an electrical diploma holder must be competent to repair and maintain these Induction, Synchronous and Special Electric Machines (SEM) used in different applications and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines.

MEANS OF ASSESSMENT

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

RECOMMENDED BOOKS:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-294)

2. Mittle, V.N. and Mittle, Arvind., Basic Electrical Engineering, McGraw Hill Education New Delhi, ISBN :9780070593572

3. Kothari, D. P. and Nagrath, I. J., Electrical Machines, McGraw Hill Education. New Delhi, ISBN:9780070699670

4. Bhattacharya, S. K., Electrical Machines, McGraw Hill Education, New Delhi, ISBN:9789332902855

5. Theraja, B.L., Electrical Technology Vol-II (AC and DC machines), S.Chand and Co. Ltd., New Delhi, ISBN : 9788121924375

6. Sen, S. K., Special Purpose Electrical Machines, Khanna Publishers, New Delhi, ISBN: 9788174091529

7. Janardanan E. G, Special Electrical Machines, Prentice Hall India, New Delhi ISBN: 9788120348806

8. Hughes E., Electrical Technology, ELBS

9. Cotton H., Electrical Technology, ELBS

10. Dr. T.D. Bisht, Pooja Yadav, Electrical Machines-II , Asian Publishers, Muzaffarnagar. ISBN: 978-93-91541-98-9

DEE- 403
FUNDAMENTS OF POWER ELECTRONICS

COURSE OBJECTIVES

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

• Maintain the proper functioning of power electronic devices.

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COURSE OUTCOME:

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

CO1 : Understand the construction, working, and specifications of power electronic devices (SCR, IGBT, TRIAC, DIAC) and test their characteristics.

CO2: Analyze various Turn-on (Triggering) and Turn-off (Commutation) methods for SCRs and demonstrate them using experimental circuits and real-world applications.

CO3 : Analyze single-phase controlled rectifiers with R and RL loads to determine output voltage and waveform characteristics.

CO4 : Understand the working principles of Inverters, Choppers, Dual Converters, and Cyclo-converters and test their performance.

COURSE CONTENT

Units	Topics	No. of Lectures
1st	**Power Electronic Devices** Power Electronic Switch Specifications : Power Diode, Power transistor, IGBT, GTO, DIAC, TRIAC SCR – rating and their importance, Symbol, Circuit, Working, Characteristics, Protection and Applications - Battery charger using SCR, Emergency light system, Temperature controller using SCR Working Principle of UJT	(8 Periods)
2nd	**Turn-on and Turn-off Methods of Thyristors** SCR Turn-On methods: Voltage triggering, Thermal triggering, Illumination triggering, dv/dt triggering, Gate triggering. SCR triggering using UJT, PUT: Relaxation Oscillator and Synchronized UJT circuit. Pulse transformer and opto-coupler based triggering. Application: UPS and SMPS. SCR Turn-Off methods: Natural & Forced Commutations	(8 Periods)
3rd	**Phase Controlled Rectifiers** Phase control: firing angle, conduction angle, extinction angle. Single phase half controlled, full controlled and midpoint-controlled rectifier with R, RL load: Circuit diagram, working, input- output waveforms, equations for DC output and effect of freewheeling diode. Different configurations of bridge-controlled rectifiers: Full-Wave & Half Wave	(6 Periods)
4th	**Inverters, Choppers, Dual Converters, Cyclo-converters** Inverter: Introduction, working principles, voltage and current driven series and parallel inverters and applications Choppers: Introduction, types of choppers and their working principles and applications Dual converters: Introduction, working principles and applications Cyclo-converters: Introduction, types, working principles and applications.	(6 Periods)

INSTRUCTIONAL STRATEGY

The teachers may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

MEANS OF ASSESSMENT

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

TEXT BOOKS/REFERENCE BOOKS:

1. Ramamoorty M., An Introduction to Thyristors and their applications, East-West Press Pvt. Ltd., New Delhi, ISBN: 8185336679.
2. Sugandhi, Rajendra Kumar & Sugandhi, Krishna Kumar, Thyristors: Theory and Applications, New Age International (P) ltd. Pub., New Delhi, ISBN: 978-0-85226-852-0.
3. Bhattacharya, S.K., Fundamentals of Power Electronics, Vikas Publishing House Pvt. Ltd. Noida. ISBN: 978-8125918530.
4. Jain & Alok, Power Electronics and its Applications, Penram International Publishing (India) Pvt. Ltd, Mumbai, ISBN: 978-8187972228.
5. Rashid, Muhammad, Power Electronics Circuits Devices and Applications, Pearson Education India, Noida, ISBN: 978-0133125900.
6. Singh, M. D. and Khanchandani, K.B., Power Electronics, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2008 ISBN: 9780070583894.
7. Zbar, Paul B., Industrial Electronics: A Text –Lab Manual, McGraw Hill Publishing Co. Ltd., New Delhi, ISBN: 978-0070728226.
8. Grafham D.R., SCR Manual, General Electric Co., ISBN: 978-0137967711.

DEE- 404 INDUSTRIAL AUTOMATION & CONTROL

L	T	P
1	-	4

COURSE OBJECTIVES

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

• Maintain Industrial Automation Systems

COURSE OUTCOMES:

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

CO1 : Explain the necessity of Industrial Automation and classify systems into Fixed, Programmable, and Flexible types.

CO2: Identify the building blocks of a PLC (CPU, I/O Modules) and select appropriate modules for interfacing with field devices.

CO3 : Develop and test PLC programs using Ladder Logic for applications like Traffic Control, Motor Sequencing, and Tank Level control.

CO4 : Demonstrate the interfacing of analog sensors (RTD/Thermocouple) with PLCs and control the speed of motors using Variable Frequency Drives (VFD).

CO5: Design SCADA Mimic diagrams, define Tags, and interface them with PLC systems using OPC architecture for process monitoring.

COURSE CONTENT

Units	Topics	No. of Lectures
1st	**Introduction to Industrial Automation** Need and benefits. Types of automation system: Fixed, Programmable, Flexible Different systems used for Industrial automation: PLC, HMI, SCADA, DCS, Drives.	(2 Periods)
2nd	**PLC Fundamentals Building blocks of PLC** Components of PLC- CPU, Memory organization, Input- output modules (discrete and analog), I/O Modules, Power supply, Fixed and Modular PLC, Redundancy in PLC module, I/O module selection criteria, Interfacing different I/O devices with appropriate I/O modules.	(2 Periods)
3rd	**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.	(5 Periods)
4th	**Electric Drives and special machines** Electric drives: Types, functions, characteristics, four quadrant operation. DC and AC drive controls: V/F control, Parameters, direct torque control. Drives: Specifications, ApplicationsSpeed control of AC motor /DC Motor	(2 Periods)

5th	**Supervisory Control and Data Acquisition (SCADA) System** Introduction to SCADA: Typical SCADA architecture/block diagram, Benefits of SCADA Various editors of SCADA Interfacing SCADA system with PLC: Typical connection diagram, Object Linking & embedding for Process Control (OPC) architecture, Steps in Creating SCADA Screen for simple object, 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	(3 Periods)

INSTRUCTIONAL STRATEGY

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

RECOMMENDED BOOKS:

1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005, ISBN 13: 9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN: 9788174092281
3. Petruzella, F.D., Programmable Logic Controllers, McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386
4. Hackworth, John; Hackworth, Federic, Programmable Logic Controllers, PHI Learning, New Delhi, 2003, ISBN: 9780130607188
5. Stenerson Jon, Industrial automation and Process control, PHI Learning, New Delhi, 2003, ISBN: 9780130618900
6. Mitra, Madhuchandra; Sengupta, Samarjit, Programmable Logic Controllers and Industrial Automation - An introduction, Penram International Publication, 2015, ISBN: 9788187972174
7. Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 9781936007097

DEE 405 Elective-II -
(E-II) RENEWABLE ENERGY POWER PLANTS

COURSE OBJECTIVES

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

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

COURSE OUTCOMES

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

CO1: Explain the classification, construction, and working principles of solar thermal and PV systems.

CO2: Describe layouts, and operating principles of geared and direct-drive large wind power plants.

CO3: Analyze the design, working, and installation of horizontal and vertical axis small wind turbines.

CO4: Explain the energy conversion process, classification, and turbine selection for micro hydro power plants.

CO5: Evaluate the properties of solid, liquid, and gaseous biomass fuels.

COURSE CONTENT

Unit – I: Solar PV and Concentrated Solar Power Plants (07 Periods)

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

Unit – II: Large Wind Power Plants (09 Periods)

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

Unit – III: Small Wind Turbines (08 Periods)

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

Unit – IV: Micro Hydro Power Plants (09 Periods)

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

(c) Low head – Kaplan turbine. Pumped storage hydro power plants. Safe Practices for micro hydro power plants.

Unit – V: Biomass-based Power Plants (09 Periods)

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

RECOMMENDED BOOKS:

1. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736

2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd – Renewable Energy Systems, Pearson Education New Delhi, ISBN: 9789332586826.

3. Rachel, Sthuthi; Earnest, Joshua – Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9

4. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043

5. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304

6. Wizelius, Tore &Earnest, Joshua -PHI Learning, New Delhi, ISBN: 978-8120351660

8. Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9

9. Bhadra, S.N., Kastha, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.

10. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978- 9386173-683).

(E-II) BIOMASS AND MICRO-HYDRO POWER PLANTS

COURSE OBJECTIVES:

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

• Maintain the efficient operation of various types of Biomass and Micro hydro power plants.

COURSE OUTCOMES(CO):

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

CO1: Explain the types of biomass fuels and interpret the layouts of bio-chemical, thermo-chemical, and agro-chemical power plants.

CO2: Describe the principle of biomass gasification, the construction of gasifiers, and power generation using gas engines..

CO3: Analyze the specifications and working of specific gasifiers (Rice Husk, Bamboo, Coconut, Bagasse) and Gobar gas plants for appropriate selection.

CO4: Classify micro-hydro power plants based on head and explain their general layout, energy conversion process, and site selection.

CO5: Discuss the construction and working of hydraulic turbines (Pelton, Francis, Kaplan) and apply safety and maintenance practices for micro-hydro plants.

COURSE CONTENTS

Unit – I: Basics of Biomass-based Power Plants (7 Periods)

Types of biomass fuel- bagasse, wood chips, rice husk, municipal waste, Jatropha, bio-diesel, gobar gas, Layout of a Bio-chemical based (e.g. biogas) power plant Layout of a Thermo-chemical based (e.g. Municipal waste) power plant Layout of an Agro-chemical based (e.g. bio-diesel) power plant Selection of biomass power plants.

Unit – II: Biomass Gasification Power Plants (8 Periods)

The basic principle to convert Agriculture and forestry products and wood processing remains (including rick husks, wood powder, branches, offcuts, corn straws, rice straws, wheat straws, cotton straws, fruit shells, coconut shells, palm shells, bagasse, corncobs) into combustible gas. General Construction and working of a typical gasifier. Power generation in gas engine.

Unit – III: Different Types of Gasifiers (9 Periods)

Construction, working and limitations of the following types of gasifiers: Rice Husk Gasification Power Plant and their specifications, Straw Gasification Power Plant and their specifications. Bamboo Waste, Bamboo Chips Gasification Power Plant and their specifications. Coconut shell, coconut peat, coconut husk, Gasification Power Plant and their specifications. Bagasse/Sugar Cane Trash Gasification Power Plant and their specifications. Gobar gas plant and its specifications.

Unit – IV: Micro-hydro Power Plants (9 Periods)

Locations of micro-hydro power plant. Energy conversion process of hydro power plant. Classification of hydro power plant: High, medium and low head. General Layouts of typical micro-hydro power plant. Strengths and limitations of micro-hydro power plants.

Unit – V: Different types of Micro-hydro power plants (9 Periods)

Construction and working of High head – Pelton turbine and their specifications. Construction and working of medium head – Francis turbines and their specifications. Construction and working of Low head – Kaplan turbine and their specifications. Preventive and breakdown maintenance of micro-hydro power plants. Safe Practices for micro-hydro power plants.

RECOMMENDED BOOKS:

1. Khoiyangbam, R S Navindu; Gupta and Sushil Kumar; Biogas Technology: Towards Sustainable Development; TERI, New Delhi; ISBN: 9788179934043.

2. David M. Buchla; Thomas E. Kissell; Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi, ISBN: 9789332586826.

3. Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI.

4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning.

5. O.P. Gupta, Energy Technology, Khanna Publishing House, ISBN: 978-93-86173-683.

ELECTRICAL MACHINE-II LAB

L	T	P
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LIST OF PRACTICALS (To perform any Ten practicals)

1. Identify the different parts (along with function and materials) for the given single phase and three phase induction motor.

2. Connect and run the three-phase squirrel cage induction motors (in both directions) using the DOL, star-delta, auto-transformer starters (any two).

3. Perform the direct load test on the three-phase squirrel cage induction motor and plot the

(a) efficiency versus output, (b) power factor versus output, (c) power factor versus motor current and (d) torque – slip/speed characteristics.

4. Conduct the No-load and Blocked-rotor tests on given 3-phase squirrel cage induction motor and determine the equivalent circuit parameters .

5. Control the speed of the given three phase squirrel cage/slip ring induction motor using the applicable methods: (a) auto-transformer, (b) VVVF.

6. Measure the open circuit voltage ratio of the three-phase slip ring induction motor.

7. Conduct the direct load test to determine the efficiency and speed regulation for different loads on the given single phase induction motor; plot the efficiency and speed regulation curves with respect to the output power.

8. Demonstrate that power factor of an induction motor load is improved by connecting capacitor bank.

9. Perform the direct loading test on the given three phase alternator and determine the regulation and efficiency.

10. Determine the regulation and efficiency of the given three phase alternator from OC and SC tests (Synchronous impedance method)

11. Conduct the test on load or no load to plot the ‘V’ curves and inverted ‘V’ curves (at noload) of 3 phase synchronous motor.

12. Synchronization of 3 Phase Alternators by a) Lamp method. b) Synchroscope method

13. Control the speed and reverse the direction of stepper motor

14. Control the speed and reverse the direction of the AC servo motor

15. Control the speed and reverse the direction of the DC servo motor

FUNDAMENTS OF POWER ELECTRONICS LAB

L	T	P
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LIST OF PRACTICALS

1. Identification & testing of SCR , TRIAC, DIAC , MOSFET and IGBT using a digital multimeter.

2. Obtain V-I characteristics of SCR.

3. Plot the V-I characteristics of IGBT and determine the break over voltage.

4. Plot the V-I characteristics of DIAC and determine the break over voltage.

5. Determine the latching current and holding current using V-I characteristics of SCR.

6. Plot the V-I characteristics of TRIAC and determine the break over voltage.

7. Illumination control / fan speed control through TRIAC.

8. Test the variation of R, C in R and RC triggering circuits on firing angle of SCR.

9. To Study UJT Triggering Techniques for Half Wave Controlled rectifiers.

10. To Study UJT Triggering Techniques for Full Wave Controlled rectifiers.

11. Perform the operation of Class – A, B, C, turn off circuits.

12. Perform the operation of Class –D, E, F turn off circuits.

13. Use CRO to observe the output waveform of half wave-controlled rectifier with resistive load and determine the load voltage.

14. Draw the output waveform of Full wave-controlled rectifier with R load, RL load, freewheeling diode and determine the load voltage.

15. Determine the firing angle using DIAC and TRIAC phase-controlled circuit on output power under different loads such as lamp, motor or heater.

16. Test the performance of given SMPS, UPS.

17. Performance Measurement and Analysis of DC-DC Buck Regulator.

18. Performance Measurement and Analysis of DC-DC Boost Regulator

INDUSTRIAL AUTOMATION & CONTROL LAB

L	T	P
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NAME OF EXPERIMENT

1. Identify various automation systems available in different appliances/ devices/ machines in day-to-day use.
2. Identify various parts of the given PLC and front panel status indicators.
3. Use PLC to test the START STOP logic using two inputs and one output.
4. Develop/Execute a ladder program for the given application using following: - timer, counter, comparison, logical, arithmetic instructions.
5. Use PLC to control the following devices like lamp, motor, push button switches, proximity sensor.
6. Measure the temperature of the given liquid using RTD or Thermocouple and PLC.
7. Develop and test ladder program to blink the LED/lamp
8. Develop ladder program for Traffic light control system.
9. Develop and test ladder program for pulse counting using limit switch /Proximity sensor.
10. Develop and test ladder program for rotating stepper motor in forward and reverse direction at constant speed.
11. Identify various front panel controls of VFD (smart drive).
12. Use various functions of SCADA simulation editors to develop simple project.
13. Develop a SCADA mimic diagram for Tank level control.