



**SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING**

Shri Rawatpura Sarkar University, Raipur (C.G.)



Scheme of Teaching and Examination and Syllabus

for

Diploma (Electrical Engineering)

Semester-(VI)

(Effective from the session: 2022-23)



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Three Years Diploma in Engineering Programme
Scheme of Teaching and Examination of Diploma in Engineering Sixth
Semester
(Electrical Engineering)

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022-2023)

S.No.	Course Code	Course Title	Hours / Week			Credits	Maximum Marks			Sem End Exam Duration (Hrs)
			L	T	P		Continuous Evaluation	Sem End Exam	Total	
1	DENEE601T	Electric Traction	2	1	-	3	30	70	100	3
2	DENEE601P	Electric Traction	-	-	2	1	15	35	50	-
3	DENEE602T	Switchgear and Protection	2	1	-	3	30	70	100	3
4	DENEE602P	Switchgear and Protection	-	-	2	1	15	35	50	-
5	DENEE603T	Electrical Installation Maintenance and Testing	2	1	-	3	30	70	100	3
6	DENEE603P	Electrical Installation Maintenance and Testing	-	-	2	1	15	35	50	-
7	DENEE604T	Utilization of Electrical Power	3	1	-	4	30	70	100	3
8	DENEE604P	Utilization of Electrical Power	-	-	2	1	15	35	50	-
9	DENEE605T	Elective II	2	1	-	3	30	70	100	3
10	DENEE606P	Project-Industry based	-	-	2	1	15	35	50	-
						21			750	

Elective II

A. Entrepreneurship Development

C. Power Quality

E. Renewable and Distributed Energy Systems

B. HVDC Power Transmission

D. Flexible AC Transmission Systems



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Course Title	Electric Traction				
Course Code	DENEE601T				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Electrical machines – I&II				
Course Objectives	<ul style="list-style-type: none"> • Provides knowledge on electrical traction systems • To impart the knowledge of Electric Traction, Electric heating, Electric welding and Illumination • To make students capable of analyzing and solving the varieties of problems and issues in electric power utilization 				
Course Contents	<p>UNIT-I</p> <p>Overview of Electrical Traction System In India Electric Drive – strengths and limitations, Choice of traction system in India</p> <p>UNIT-II</p> <p>Systems of Track Electrification: Description of various systems D.C., 1-phase low frequency A.C., 1-phase high frequency at 3-phase A.C. and composite system, 25 K.V. 1 phase A.C., 50 Hz systems – strengths and limitations, Problems associated with A.C. traction system. Current & voltage unbalance, Comparison between A.C. and D.C. systems.</p> <p>UNIT-III</p> <p>Traction Mechanics: Speed time curve, Simplified speed time, Average speed and schedule speed tractive effort, Specific energy consumption, Factors affecting specific energy consumption, Mechanics of train movement, Coefficient of adhesion, factors affecting the coefficient of adhesion.</p> <p>UNIT-IV</p> <p>Operation and Control of Electric Traction System: Control of DC traction system, Remote control system equipment and network, General principle of operation, Supervisory and alarm facilities, Frequency allocation.</p> <p>UNIT-V</p> <p>Electric locomotive maintenance: Need & types of maintenance, Method of reducing maintenance cost, Maintenance record</p>				



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Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• Identify different traction systems.• Differentiate speed time curve of different services of traction system.• Get exposure with modern trends in traction.
Text Books	1. Modern Electric Traction H. Partab Dhanpat Rai and Sons, New Delhi
Reference Books	2. Electric Traction J. Upadhyay S. N. Mahendra Allied Publishers Ltd., Dhanpat Rai and Sons, New 3. Generation, Distribution & utilization of electrical energy J. Upadhyay S. N. Mahendra



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Course Title	Switchgear and Protection				
Course Code	DENEE602T				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Basic Electrical Engineering				
Course Objectives	<ul style="list-style-type: none"> • To introduce students to power system protection and switchgear. • To teach students theory and applications of the main components used in power system protection for electric machines, transformers, bus bars, overhead and underground feeders. • To teach students the theory, construction, applications of main types Circuit breakers, Relays for protection of generators, transformers and protection of feeders from over- voltages and other hazards. It emphasis on neutral grounding for overall protection 				
Course Contents	<p>UNIT-I</p> <p>Principles of Protection Line diagram of a power system and its elements, Faults and abnormalities, their causes, types and effects, Functions of basic elements of a protective system, Backup protection and its types, Importance of neutral earthing, Methods of neutral earthing and its advantages.</p> <p>Over Voltage Protection Causes and effects of over voltages, Methods of reducing over voltages, Types , Operating principles, applications of lightning arrestor, Surge absorber.</p> <p>UNIT-II</p> <p>Protective Relays: Concept of protective relaying, Classification of relays and their selection, Construction and working principle of relays electromagnetic, induction, reverse power, differential, distance, IDMT, & thermal relay, Basic terms related to relays pick-up value, reset value and operating current, Settings of various types of relays, Causes of failure of primary relaying , Use & types of backup relays in power system.</p> <p>UNIT-III</p> <p>Instrument Transformers Instrument transformers used for protection, Polarity marking of CT & PT and their specifications, Connection diagram of CT & PT in a 1-phase and 3-phase protective systems</p> <p>UNIT-IV</p> <p>Circuit Interrupting Devices Necessity and types of interruption devices like ACB, OCB, AB Switch, SF6 and</p>				



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	<p>vacuum circuit breakers & their working principle, Line diagram of a protective system showing different circuit interrupting devices, Arc formation in CB & methods of arc extinction, Terms related to circuit interruption wave form, Requirement and types of isolators, Difference between isolators & CB, Types of fuses and their characteristic.</p> <p>UNIT-V</p> <p>Protection Schemes</p> <p>Abnormalities and faults in a power system and its effects, Protection schemes for alternator, Protection against prime mover failure and unbalance loading, Protection of transformers, Protection of transmission line and feeders, Protection of induction motors</p>
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• Acquire the knowledge of various abnormal conditions that could occur in power system.• To know of various types of existing circuit breakers, their design and constructional details.• Knowledge of various conventional relays, their design and latest developments
Text Books	<p>1. Power System Protection and Switchgear Badraram/ Tata McGraw-Hill, New Delhi</p>
Reference Books	<p>1 Switchgear and Protection Deshpande/ Tata McGraw-Hill, New Delhi 2 Testing, Commissioning, Operation and Maintenance of Electrical Equipment</p>



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Course Title	Electrical Installation Maintenance and Testing				
Course Code	DENEE603T				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Switchgear and protection				
Course Objectives	<ul style="list-style-type: none"> To write down detailed specification and numbers required of different materials To determine the size and material of conductor and cable from electrical and mechanical consideration. As such to prepare a detailed list of materials with complete specifications. 				
Course Contents	<p>UNIT– I</p> <p>Installation Types of heavy Electrical equipment, unloading accessories precautions for unloading, installation of small and large machines of both static and rotating type. Installation of pole mounted transformer</p> <p>Commissioning Tests required before commissioning procedure to be adopted for commissioning the electrical equipment in respect of Mechanical fixture and alignment, Electrical tests. Initial precautions for starting.</p> <p>UNIT – II</p> <p>Earthing Reasons of earthing, Earthing system earth lead and its size, Permissible earth resistance for different installations, Improvement of earth resistance, Double earthing earth resistance measurement.</p> <p>Insulation testing and maintenance Instruments used for measuring insulation resistance, Reasons for deterioration of insulation resistance, Improving insulation resistance, Drying insulation, Measurement of internal temperature of winding, Vacuum impregnation/ filtering of insulating oil. Testing of insulating oil.</p> <p>UNIT – III</p> <p>Preventive maintenance & Environmental pollution prevention Concepts of preventive maintenance, Advantages preventive maintenance schedule for transformer induction motor, Transmission line, Circuit breaker and underground cable, Preventive measures to control environmental pollution results due to production of smokes gases, Flow of waste material and atomic reactions in research stations, Plants electrical & electronic equipments and accessories.</p> <p>Trouble Shooting Normal performance of equipment, Trouble shooting internal and external faults</p>				



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	<p>Instruments and accessories for trouble shooting, Trouble shooting charts.</p> <p>UNIT – IV</p> <p>Electrical Accident & Safety measures Electrical accidents, Safety regulation, Treatment of shock, Fire extinguishers.</p> <p>Testing & Maintenance of relays & Circuit breakers Testing of relays; Factory test, commissioning test and preventive periodic maintenance test, Testing of circuit breakers, Voltage test, type test, Preventive maintenance of circuit breaker.</p> <p>UNIT – V</p> <p>Hot Line Maintenance : Meaning and advantages, Special type of non-conducting material used for preparing tools, Tools for hot line maintenance.</p>
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• Prepare specifications for different items required for transmission lines.• Design and excavation of cable trenches.• Check HT/LT circuit breakers, transformers and related equipment in a substation• Carry out preventive maintenance to minimize breakdowns
Text Books	<ol style="list-style-type: none">1. Commissioning and maintenance of Electrical equipment S. Rao/ Khanna Publications
Reference Books	<ol style="list-style-type: none">1. Fundamentals of maintenance of Electrical Equipment Bhatia/ Khanna Publications2. Electrical Maintenance & Repairs P.P. Gupta/ Dhanpat Rai & Cons Publications



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Course Title	Utilization of Electrical Power				
Course Code	DENEE604T				
Course Credits	L	T	P	TC	
	3	1		4	
Prerequisites	Electrical Machine-I & II				
Course Objectives	<ul style="list-style-type: none"> To understand the basic principles of light control and types of light schemes. To impart how to design the traction system considering economic and technology up gradation. 				
Course Contents	<p>UNIT-I Principles of Selection of Electrical Drive System : Requirements of mechanical load, Review of the electrical motor operation, Duty cycle, Principles of selection of motor, Power transmission system, Procedure to select the motor i.e. type, size & rating, Procedure to operate & control the motor i.e. starting running braking, speed, load fluctuation.</p> <p>UNIT-II Electric Heating System : Principal, Advantages and Disadvantages of electric heating system, Modes of transfer of heat, Principle of the resistance, induction and dielectric heating, Principle of heat conversion in resistance, induction, dielectric heating, Types of Furnaces – Arc and Induction Furnaces</p> <p>UNIT-III Electric Welding System : Concepts of the resistance, induction, arc metallic & carbon welding, Principles of welding, Principle of TIG and MIG welding, AC and DC Arc Welding</p> <p>UNIT-IV Illumination : Electromagnetic Wave spectrum, Law of illumination, Definitions of terms used lighting, Types of lighting scheme and their calculation, Types of lamps and their uses and fittings</p> <p>UNIT-V Power factor improvement : Causes & ill effects of low power factor, Methods of improvement of power factor & its economics</p>				



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Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition• acquaint with the different types of heating and welding techniques• basic principles of illumination and its measurement• Understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management.
Text Books	<ol style="list-style-type: none">1. Utilization of electrical energy & Electric Traction Gupta J. B.; Katson Pub. New Delhi
Reference Books	<ol style="list-style-type: none">1. Generation, Distribution & utilization of electrical energy Wadhwa, C.L./ Wiley Eastern Ltd., New Delhi2. Soni, M.L. et al; Dhanpat Rai & Sons, New Delhi A Course in Electrical power



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Course Title	Entrepreneurship Development				
Course Code	DENEE605TA				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Communication Skill-I&II				
Course Objectives	<ul style="list-style-type: none"> to develop the ability of analysing and understanding business situations in which entrepreneurs act and to master the knowledge necessary to plan entrepreneurial activities the students develop the ability of analysing various aspects of entrepreneurship – especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development 				
Course Contents	<p>UNIT-I</p> <p>Entrepreneurial Development : Definition of entrepreneurship, Characteristics of entrepreneurs, Factors influencing entrepreneurship, Need for promotion of entrepreneurship and small business Entrepreneurial Environment ,Environmental analysis, Government policies for setting up new small enterprises, Opportunities in service industries.</p> <p>UNIT-II</p> <p>Forms of Business Organization: Forms of ownership, Sole Proprietorship, Partnership, Cooperative society, Joint – stock company, Private Limited Companies, Public Limited Companies.</p> <p>Institutional support to SSI: Institutional set up, Industries centers, Industrial estates, Institutional support at National level, Institutional support at State level , Commercial banks and financial institutions</p> <p>UNIT- III</p> <p>Planning a SSI : What is planning, Types of planning, Importance of planning, Steps in planning Steps in planning a SSI, Technical dimensions for setting up an enterprise</p> <p>UNIT- IV</p> <p>Management of Small Business Firm: Functional areas of small business firm, Fundamentals of Management, Managerial effectiveness, Essential data for effective control of small business, Resource management, Office management, Employees Welfare & safety, Factory rules and Labor Laws related to SSIs, Sales Tax and Income Tax laws related to SSIs</p> <p>Project selection, Formulation & Appraisal Project selection & formulation, Scope of project report, Content & Format of</p>				



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	<p>Project report, Need of Project Appraisal, Steps of Project Appraisal.</p> <p>UNIT- V</p> <p>Entrepreneurial Motivation Training</p> <p>Achievement Motivation ,Creative thinking, Risk taking abilities</p>
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• state the meaning of entrepreneurship• describe the importance of entrepreneurship• describe the entrepreneurial practices in India• distinguish between entrepreneur and promoter
Text Books	<p>1 Entrepreneurship development in India Dr. C.B. Gupta Dr. N.P. Srinivasan Sultan Chand & Sons.</p>
Reference Books	<p>1 Entrepreneurship Development in small scale proceedings of National Seminar, DCSSI, New Delhi</p>



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Course Title	HVDC Power Transmission				
Course Code	DENEE605TB				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Power Electronics				
Course Objectives	<ul style="list-style-type: none"> • To understand the usage of HVDC and AC transmission Systems • To identify and compare the operation of three pulse and six pulse converter station. • To acquire knowledge controllers for controlling the power flow through a dc link and effects of harmonics on the system. • To analyze concepts of converter fault and protection and converter control characteristics. • To compare the basic operation and performance of Multi Terminal DC System 				
Course Contents	<p>Unit-I HVDC Transmission basics Introduction to DC Power Transmission, Necessities of HVDC interconnection, Comparison of HVDC and AC Transmission systems, DC link types, HVDC power system components, – Thyristors valve, dynamic characteristics, parallel & series connection of thyristors, Planning for HVDC transmission.</p> <p>Unit-II HVDC Converter Circuit Analysis Rectification, choice of converter configurations, Analysis of Graetz circuit with and without overlap, voltage waveforms, Analysis of two and three valve conduction mode, Converter Bridge characteristics, Inverter mode of operation, voltage waveforms.</p> <p>Unit-III Principles of HVDC link control Principles of DC link control, Converter Control characteristics, Control hierarchy Constant current Control, CEA Control, firing angle control of valves, starting, and stopping of a dc link, Power control, converter fault and protection against over current, over voltage in converter protection of DC Line and DC circuit breaker.</p> <p>Unit-IV Harmonics and Filters Reactive power control: reactive power requirement in steady state, sources of reactive power and reactive power control. Harmonics and Filters: Generation of harmonics, Characteristics and non-Characteristics harmonic, types of ac filter: single tuned and double tuned filter, high pass filter, DC smoothing reactor and filters</p> <p>Unit-V Multi-terminal Types of MTDC system</p>				



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	Introduction – Study of MTDC systems, comparison of series and parallel MTDC system, Potential applications of MTDC systems, Types of MTDC systems, Control and protection of MTDC systems
Course Outcomes	At the end of this course student will be able to: •
Text Books	<ol style="list-style-type: none">1. High Voltage Direct Current Transmission by Arrillaga J, Peter Pregrinus, London, 2007.2. Direct Current Transmission Vol.I by E. W. Kimbark., Wiley Interscience, 1971
Reference Books	<ol style="list-style-type: none">1. HVDC Transmission Systems Technology and System Interactions by K. R. Padiyar, New Age International Publishers.2. Power Transmission by Direct Current by Erich Uhlmann, BS Publications, 2004



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Course Title	Power Quality				
Course Code	DENEE605TC				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Power System and Power Electronics				
Course Objectives	<ul style="list-style-type: none"> • To develop understandings of power quality issues. • To enhance the ability to find out the solutions for those power quality issues. • To impart knowledge of different power quality improvement methods. 				
Course Contents	<p>Unit-I Introduction Power quality-voltage quality-overview of power quality phenomena-classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C-message weights-flicker factor transient phenomena occurrence of power quality problems-power acceptability curves-IEEE guides, standards and recommended practices.</p> <p>UNIT-II Harmonics Individual and total harmonic distortion-RMS value of a harmonic waveform-triplex harmonics-important harmonic introducing devices-SMPS-Three phase power converters-arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads. Modelling of networks and components under non-sinusoidal conditions transmission and distribution systems- shunt capacitors-transformers-electric machines-ground systems loads that cause power quality problems-power quality problems created by drives and its impact on drives.</p> <p>UNIT-III Power factor improvement Passive Compensation. Passive Filtering. Harmonic Resonance. Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter. Static VAR compensators-SVC and STATCOM.</p> <p>UNIT-IV Active Harmonic Filtering - I Shunt Injection Filter for single phase, three-phase three-wire and three-phase four-wire systems. d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage transformers- series active power filtering techniques for harmonic cancellation and isolation.</p> <p>UNIT-V Active Harmonic Filtering – II Dynamic Voltage Restorers for sag , swell and flicker problems. Grounding and</p>				



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	wiring introduction-NEC grounding requirements-reasons for grounding typical grounding and wiring problems- solutions to grounding and wiring problems.
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• Recall knowledge of various issues related to power quality.• Experiment with the significance of harmonics.• Analyse the performance of power factor improvement methods.• Design of harmonic minimization techniques
Text Books	<ol style="list-style-type: none">1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007.2. Math H. Bollen, "Understanding Power Quality Problems : Voltage Sags and Interruptions", Wiley India Pvt. Ltd., 2011.3. J. Arrillaga N.R. Watson, S. Chen, "Power System Quality Assessment", Wiley India Pvt. Ltd., 2011.4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood , "Power system Harmonic Analysis", 1st Edition, Wiley India Exclusive (CBS), 2018.
Reference Books	<ol style="list-style-type: none">1. R.C. Dugan, Mark F Mcgranaghan, H Wayne Beaty, Surya Santoso, "Electrical Power Systems Quality", 3rd edition, Mc-Graw-Hill Education, 2017.2. Derek A. Paice, Power Electronic Converter Harmonics : Multipulse Methods for Clean Power, 1st edition, Wiley-IEEE Press, 1999.3. T J E Miller, Reactive Power Control In Electric Systems, Wiley India Pvt. Ltd, 2010.



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Course Title	Flexible AC Transmission Systems				
Course Code	DENEE605TE				
Course Credits	L	T	P	TC	
	2	1	-	3	
Prerequisites	Power Electronics				
Course Objectives	<ul style="list-style-type: none"> To impart the knowledge and tackle the problem of regulatory constraints on the expansion of power transmission network by introduction of high power electronic controllers for regulation of power flow and voltages in the AC transmission network. 				
Course Contents	<p>UNIT-I Introduction to Flexible AC transmission systems Introduction of semiconductor devices, Flow of power in AC system, Steady state and dynamic problems in AC systems loading capability, controllable parameters, basic types of FACTS controllers, Flexible AC transmission systems (FACTS) Basic realities & roles.</p> <p>UNIT-II Voltage Source Converters (VSC) Basic concepts of VSC, single-phase full wave bridge converter operation, single phase-leg operation, three-phase full wave bridge converter and its operation, transformer connections for 12-pulse, 24-pulse and 48-pulse operation.</p> <p>UNIT-III Current source converters (CSC) Basic concepts, three-phase CSCs, three-phase full wave rectifier, comparison of VSC and CSC. Static shunt compensators: basic concepts, method of controllable VAR generation, Static VAR compensator,(SVC), application of SVC in power systems.</p> <p>UNIT-IV Shunt Compensators Introduction, mathematical model, working of STATCOM, V-I and V-Q characteristics, transient stability enhancement and exchange of real power using STATCOM, comparison of SVC and STATCOM, Merits of hybrid compensators.</p> <p>UNIT-V Series Compensators</p>				



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	Objectives of series compensation, variable impedance type series compensation, GTO thyristor controlled series capacitors (GCSC), thyristor controlled series capacitor (TCSC), basic concepts of GCSC and TCSC, static synchronous series compensator (SSSC). Introduction to Unified Power Flow Controller (UPFC).
Course Outcomes	At the end of this course student will be able to: <ul style="list-style-type: none">• Understand transmission bottle necks and the methods to overcome them.• Know the method of series and shunt compensation for improvement of power quality.• Simulate different FACTS controllers and analyzing their effects.• Undertake projects on power quality improvements using FACTS devices.
Text Books	<ol style="list-style-type: none">1. Narain G. Hingorani, "Understanding FACTS", Wiley India Pvt. Ltd., 2011.2. Mathur, R.M. and Verma, R.K, "Thyristor-Based FACTS Controllers for Electrical Transmission Systems", Wiley-IEEE Press, 1st edition, 2002
Reference Books	<ol style="list-style-type: none">1. Song, Yu, "FACTS for Transmission lines".2. G.T. Heydt, "Power Quality", Stars in a Circle Publications, Indiana, 1994.3. T.J.E. Miller, "Static Reactive Power Compensation", Wiley India Pvt. Ltd.,2010.4. Padiyar. K. R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007



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Course Title	Renewable and Distributed Energy Systems				
Course Code	DENEE605TB				
Course Credits	L	T	P	TC	
	3	1	-	4	
Prerequisites	Basic Electrical Engineering				
Course Objectives	<ul style="list-style-type: none"> • To make the students appreciate the significance of distributed energy resources in the present scenario. • To acquaint the students with fundamentals of the integration of renewable sources with the utility grid. 				
Course Contents	<p>UNIT-I Wind Energy System Introduction to renewable energy system, Environment aspects of energy utilization, World energy supplies, Wind resource assessment, Wind power system components, Power conversion technologies and applications, Characteristics and Power Generation from Wind Energy, Wind power estimation technique, Aerodynamics of wind turbine blades, Various aspects of wind turbine design, Wind turbine generators, Reactive power compensation, Site selection, Planning of wind farms, maintenance and operation, Environmental assessment.</p> <p>UNIT-II Solar Energy System Present and Future scope of Solar Energy, Solar radiation, Photo-voltaic effect, Type of PV cells, Electrical properties, Equivalent circuit, Cell characteristics, Effect of temperature variation, PV cell model, PV module, Grid connected and islanded system, Technical and non-technical consideration- system size and module choice.</p> <p>UNIT-III Stand-alone systems: Stand-alone systems: Modules, Batteries, charge controllers.</p> <p>UNIT-IV Hydrogen as renewable energy and Hybrid Energy System Source of Hydrogen, Fuel for Vehicle Hydrogen Production, Biological AND Biochemical methods of hydrogen production, Storage of Hydrogen, Fuel cell- Principle of working, construction and applications, Hybrid wind energy systems.</p> <p>UNIT-V</p>				



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	<p>Distributed Generation (DG)</p> <p>Overview and technology trends, Introduction to distribution systems, distribution system equipment, grounding, sequence analysis and fault calculations, relaying requirements for Distributed Generation (DG) system Intentional and unintentional islanding, power converter topologies for grid interconnection, filtering requirements. Selection of power converter components, Economic Aspects of Distributed Generation, Micro- grid with Distributed Energy Resources.</p>
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• Appraise the concept of renewable energy system and their role in our society.• Understand the operating concept, components and application of wind energy system.• Interpret the concept, application and analyze the performance of solar energy system.• Acquire the knowledge of construction, application and performance of hybrid energy system.• Infer the concept and utility of energy storage and micro-grid
Text Books	<ol style="list-style-type: none">1. Godfrey Boyle, "Renewable energy power for a sustainable future", Oxford University Press, Third edition, 2012.2. Khan B. H., "Non-Conventional Energy Resources", McGraw Hill Education India Private Limited, Third edition, 2017.3. D.P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable energy sources and emerging technology", Prentice4. Hall India Learning Private Limited, 2Nd edition, 2011.
Reference Books	<ol style="list-style-type: none">1. Twidell, J., Tony W., "Renewable Energy Resources", 2nd Edition, ROUTLEDGE BSP, 2019.2. Kreith F., Kreider J.F., "Solar Energy Handbook", McGraw-Hill Inc.3. Nikos Hatziargyriou, "Micro-grids: Architectures and Control", Wiley, 2014



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Course Title	Electric Traction				
Course Code	DENEE601P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Basic electrical engineering				
Course Objectives	<ul style="list-style-type: none">• To visit the railways repair shop at a nearby station, for study of electric locomotive.• Develop ability amongst the students to design -heating element for resistance furnaces and design- illumination schemes. To develop ability amongst the students to analyze the performance of arc furnaces, electric traction, different sources of light, illumination schemes• Ensure that the knowledge acquired can be applied in various fields such as electric heating, illumination, chemical processes, and electric traction				
Course Contents	PRACTICAL EXPERIENCES 1. Visit to the railway maintenance section of Indian Railways followed by report of <ol style="list-style-type: none">a) Operation of the electrical systemb) Control room operationsc) Switchgear and protectiond) Maintenance of locomotive and other equipmente) Power supply, return supply and wiring system. 2. Study of different current collectors in AC and DC system 3. Study of metro DC traction system 4. Study of PSI system				
Course Outcomes	At the end of this course student will be able to: <ul style="list-style-type: none">• Design simple resistance furnaces and residential illumination schemes.• Calculate tractive effort, power, acceleration and velocity of traction.• Get knowledge of principle of electric heating, welding and its applications.				
Reference Books	1. Generation, Distribution & utilisation of electrical energy Wadhwa, C.L./ Wiley Eastern Ltd., New Delhi				



SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Course Title	Switchgear And Protection				
Course Code	DENEE602P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Basic Electrical Engineering				
Course Objectives	<ul style="list-style-type: none">• verify the characteristics of over current Relay• To conduct experiments to verify the characteristics of over voltage relay• To verify the operation of negative sequence relay• To conduct experiments on motor protection.				
Course Contents	<p>List of Experiments: (At least Ten experiments are to be performed by each student).</p> <p>a) Use overload relay and obtain it's time-current characteristic</p> <p>b) Use Buchholz relay for transformer protection</p> <p>c) Use thermal overload relay for protection of motor and set the relay property</p> <p>d) Check the polarity of CT & PT and connect it with the relay</p> <p>e) Apply the balance current protection scheme using appropriate switch gear</p> <p>f) Find the fusing factor of a given fuse material</p> <p>g) Operate air break switch in a simulated condition</p> <p>h) Read and interpret the protection scheme for an alternator in power station (from blue print and visit)</p> <p>i) Read and interpret various protective scheme used for transmission lines and feeders (from blue print and visit)</p> <p>j) Draw schematic diagram of protective schemes for 66KV, 132KV, 220KV substation (after visit)</p> <p>k) Visit a substation and prepare its technical report emphasizing on control side.</p>				
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• Experimentally verify the characteristics of negative sequence relay• Show knowledge of protecting generator• Show knowledge of protecting Motor• Measure breakdown strength of transformer oil				



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Text Books	1. Power System Protection and Switchgear Badriram/ Tata McGraw-Hill, New Delhi
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Course Title	Electrical Installation Maintenance and Testing				
Course Code	DENEE603P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Basic Electrical & measuring Instrument				
Course Objectives	<ul style="list-style-type: none">• To verify proper functioning of the equipment/system after installation• To verify that the performance of the installed equipment/systems meet with the specified design intent through a series of tests and adjustments.• To capture and record performance data of the whole installation as the baseline for future operation and maintenance.• To gain knowledge of testing, installation and maintenance of electrical appliances, their trouble shooting and electrical safety.				
Course Contents	<p>List of experiments: (At least Ten experiments are to be performed by each student) The following experiments may be demonstrated either in institute or in field.</p> <ol style="list-style-type: none">1. Maintenance of O.H. Lines.2. Maintenance of switchgear OCB.3. Maintenance of distribution transformer in distribution system.4. Routine/ Preventive maintenance of induction motors in textile mills/ industrial establishment.5. Shut down and energizing procedure.6. Accident reports writing.7. Permit to work.8. Fire extinguisher.9. Insulation oil testing.10. Earth resistance testing.11. Test report of electrical installation.12. Maintenance schedule.13. Trouble shooting.14. Report on hot line maintenance.				



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Course Outcomes	At the end of this course student will be able to: <ul style="list-style-type: none">• To know the installation, commissioning and maintenance of different electrical components.• Understand concepts of commissioning, maintenance, electrical safety, installation and maintenance of domestic appliances.
Text Books	1. Estimating Commissioning and maintenance of Electrical equipment S. Rao/ Khanna Publications



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Course Title	Utilization of Electrical Power				
Course Code	DENEE604P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Electrical Machine- I&II				
Course Objectives	<ul style="list-style-type: none">• The objective of the course is to operate and maintain main electrical utilities for their efficient operations.• To make them understand concepts of utilization of Electrical Energy				
Course Contents	<p>List of experiments:</p> <p>(At least Ten experiments are to be performed by each student)</p> <ol style="list-style-type: none">1. Visit to the medium size manufacturing industry and observe the drive, arrangement, instrumentation & control system, procedures, instrumentation, tools, machines & sequencing of operation.2. Write report. Draw the plant layout. State the principles of the operation and control of the manufacturing system.3. Select the heating procedure for the study.4. Select welding process, either visit or video demonstration.5. Visit to the railway maintenance section and report of operation, control, switchgear and protection and maintenance of locomotive and other traction equipment, power supply, return supply and wiring system.				
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none">• maintain electric drives used in industries, also identify a heating/welding scheme for a given application.• figure-out the different schemes of traction schemes and its main components and identify the job/higher education/research opportunities in Electric Utilization industry				
Text Books	1. Utilization of electrical energy & Electric Traction Gupta J. B.; Katson Pub. New Delhi				



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Course Title	Project-Industry Based				
Course Code	DENEE606P				
Course Credits	L	T	P	TC	
	-	-	2	1	
Prerequisites	Basic Electrical Engineering				
Course Objectives	<ul style="list-style-type: none"> • To provide knowledge of Basic Electric Circuit Concepts. • Specific: Project should target a specific goal • Measurable: It should be quantifiable • Realistic: It should be realistic in nature 				
Course Contents	<p>List of experiments: (At least Ten experiments are to be performed by each student)</p> <ol style="list-style-type: none"> 1. The basic objective of the Mini Project is to inculcate the habit of enquiry, Team work, Confidence to tackle new problems and to develop their skill so that they can successfully make their minor / major project in higher semesters. 2. The Mini Project model must be prepared INHOUSE (in college) on their own. For this, components must be brought by the students and Tools/ Accessories will be provided by the institute. It is again highlighted that the mini project MUST be prepared in the Project Lab / Workshop in the presence of supervisor. 3. The Mini Project must be submitted along with typed report, in the same format as the report for Major project is submitted. The report will be Soft bound with transparent sheet stapled at the top and bottom, Stapled side must be covered with Tape. 4. Projects may be selected from Electrical / Electronic Magazines, books, journals. Highly advanced circuit using Microcontroller etc are not expected at this stage. Common Mini Projects may also be prepared. 5. Mini project must be Hardware based working model. Software based projects are not permitted as mini project. 				
Course Outcomes	<p>At the end of this course student will be able to:</p> <ul style="list-style-type: none"> • Handle all major tools • Install ceiling fan and regulator • Check fluorescent lamp with industrial project 				
Text Books	<ol style="list-style-type: none"> 1. Experiments in basic electrical engineering, S.K.Bhattacharya. 1. Basic shop practical, Mehta & Gupta 				



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	2. Practical in electrical engineering, Dr. N.K.Jain
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