

# POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology And Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Electrical Engineering

Semester-VI

Course Code	DEEA- 601
Course Title	Electric Traction
Number of Credits	3 (L:3; T:0; P:0)

## 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 traction systems.

## Course outcomes:

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

- a) Interpret the traction layout and its systems
- b) Maintain the power supply arrangements.
- c) Maintain the function of the overhead equipment for electric traction
- d) Maintain the different components of the electric locomotive.
- e) Maintain the traction motor and train lighting system

## Course contents:

### Unit – I Basics of Traction:

General description of Electrical Traction system in India. Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive, Problems associated with AC traction System and remedies for it. Voltage balance, current balance, production of harmonics, induction effects, Metro rail system, features

### Unit – II Power Supply Arrangements

Constituents of supply system:-

Substation: layout, list of equipment and their functions

Feeding post: list of equipment and their functions

Feeding and sectioning Arrangements

Sectioning and paralleling post

Sub sectioning and Paralleling post

Sub sectioning post

Elementary section

Major equipment at substation, miscellaneous equipment at control post or switching station, Protection system for traction transformer and 25 kV centenary constructions

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## **Unit- III Overhead Equipment**

Different types of overhead equipments, Pentagonal OHE Centenary Construction, Different Types of Centenary according to speed Limit, OHE Supporting Structure, Cantilever assembly diagram Overhead system- Trolley collector, Bow collector, Pantograph Collector, Types and construction of pantograph

## **Unit- IV Electric Locomotive**

Classification and Nomenclature of Electric Locomotive

Block diagram of AC locomotive

Power Circuit of AC Locomotive

Equipment (List and Function only) used in auxiliary circuit of AC Locomotive

Loco bogie classification according to wheel arrangements

Maintenance of AC systems

## **Unit- V Traction Motors and Train Lighting**

Desirable characteristics of traction motor, Types of motors used for traction with their characteristics and features Control of motors used for traction and methods to control Requirements of braking, types of braking, Electric braking, Regenerative braking, Systems of train lighting, Single battery, double battery parallel block system SG, HOG, End on generation

## **Unit VI Signalling and Supervisory Control**

Requirements of signaling systems, Types of signals, track circuits, Advantages of remote control, Systems of remote control, equipment and network Metro rail-supply systems, advantages, schemes in India

## **References:**

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

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Course Code	DEEA- 601
Course Title	Electric Traction
Number of Credits	1 (L:0; T:0; P:2)

## Course Objectives:

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

## Course Outcomes For practical

- a) Interpret the traction layout and its systems
- b) Maintain the power supply arrangements.
- c) Maintain the function of the overhead equipment for electric traction
- d) Maintain the different components of the electric locomotive.
- e) Maintain the traction motor and train lighting system

## List of Experiment

1. To study the features, power supply system, and advantages of Metro rail systems in India.
2. To study voltage imbalance, current imbalance, harmonics, and induction effects in AC traction and their remedies.
3. To compare Electric Drive, Diesel-Electric Drive, and Battery Drive with respect to advantages and disadvantages.
4. To study the general layout and features of the Indian electric traction system (25 kV AC system).
5. To study the layout, major equipment, and functions of equipment used in a traction substation.
6. To study the equipment used in feeding post, sectioning and paralleling post (SP), and their functions.
7. To study the protection system used for traction transformer and 25 kV catenary system.

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Course Code	DEEA - 602
Course Title	Elective IV(A Electrical Estimation and contracting )
Number of Credits	3 (L:3; T:0; P:0)

## Course Objectives:

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

- Design electrical installation with costing for tendering

## Course outcomes:

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

- a) Follow the National Electrical Code (NEC) 2011 in electrical installations
- b) Estimate the electrical installation works
- c) Estimate non-industrial electrical installation works
- d) Estimate industrial electrical installation works
- e) Prepare abstracts, tenders, and quotations for public lighting and other installations
- f) Prepare abstracts, tenders, and quotations for low-tension (LT) substations

## Unit-I: Electric Installation and Safety

- Scope and features of National Electric Code (NEC) 2011
- Types of electrical installations
- Fundamental principles for electrical installation
- Permit to work, safety instructions, and safety practices
- Purpose of estimating and costing

## Unit-II: Estimation and Costing

- Types and purposes of estimates:  
Rough estimate , Detailed estimate , Supplementary estimate , Annual maintenance estimate , Revised estimate
- Factors for preparation of detailed estimate and economical execution of work
- Contracts: Concepts, types, and roles of contractors
- Tenders and Quotations:
- Tenders and Quotations:
  - Types of tenders, tender notices

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- Preparation of tender documents
- Methods of tender opening
- Quotation formats
- Comparison between tender and quotation
- Comparative statements and order formats
- Principles of work execution, planning, organizing, and billing

## **Unit-III: Non-Industrial Installations**

- Types of non-industrial installations:
  - Office buildings
  - Shopping and commercial centres
  - Residential installations
  - Electric service and supply
- Design considerations for electrical installations in commercial buildings
- Detailed design procedure
- Estimating and costing
- Earthing of commercial installations
- Electrical installation scheme for commercial complexes
- Erection, inspection, and testing as per NEC

## **Unit-IV: Industrial Installation**

- Classification of industrial buildings based on power consumption
- Wiring diagrams and single-line diagrams for single and three-phase motors
- Design considerations and detailed procedure for industrial installations
- Installation schemes for factories/small industrial units
- Preparation of material schedules and detailed estimates
- Installation and estimation of agricultural pumps and flour mills

## **Unit-V: Public Lighting Installation**

- Classification of outdoor/street/public lighting installations
- Streetlight pole structures and equipment selection
- Cable types and sizes
- Control systems for street lighting
- Design, estimation, and costing of street lighting systems
- Tender and abstract preparation
- Distribution Lines and LT Substation
- Overview of overhead and underground distribution lines
- Materials used in HT and LV distribution
- Cable types, selection factors, laying, and termination (as per IS)
- Design, estimation, and costing of HT/LT overhead lines and underground cables
- Types and line diagrams of 11 kV distribution substations
- Load estimation, load factor, diversity factor, and transformer rating

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## References:

1. Raina, K. B. & Dr. S. K. Bhattacharya, Electrical Design Estimating and Costing, New Age International, ISBN: 978-81-224-0363-3
2. Allagappan & N. S. Ekambaram, Electrical Estimating and Costing, Tata McGraw-Hill, ISBN: 9780074624784
3. Singh, Surjit & Ravi Deep Singh, Electrical Estimating and Costing, Dhanpat Rai & Sons, ISBN: 1234567150995
4. Gupta, J. B., A Course in Electrical Installation Estimating and Costing, S. K. Kataria & Sons, ISBN: 9789350142790
5. IS: 732-1989, Code of Practice for Electrical Wiring Installation, Bureau of Indian Standards
6. SP-30:2011, National Electrical Code, Bureau of Indian Standards

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Course Code	DEEA-602
Course Title	Elective IV (B Computer Application to power System)
Number of Credits	3 (L:3; T:0; P:0)

## Course Objectives:

- 1 One of the most critical areas for success in any business enterprise is how Production and Operations are managed.
- 2 To study the statistics, economics, finance, organizational behavior and strategy into a consolidated production and operation related decisions.
- 3 To discuss the role of location strategy and the criteria for location decisions.
- 4 To define quality and explain quality management, including TQM and its tools.

## Course outcomes:

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

CO1 Define operations management and explain its relationship to productivity. And also understand tools and techniques.

CO2 Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods.

CO3 Explain layout strategy and how operations managers determine facility arrangements and size.

CO4 Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity.

CO5 Understand make-or-buy decisions, and the selection and integration of suppliers. And how much to order and when to order.

Unit -I Power System Models: models of power system components, network model using graph theory, formation of Z bus, transmission line models, regulating transformer, line loadability, capability curves of alternator.

Unit- II Compensation: Control of load bus voltage using reactive power control variable, SVC & SVS, Regulated shunt compensation, series and shunt compensation, effect on loadability of transmission lines, Uniform series and shunt compensation.

Unit- III Sensitivity Analysis: Sensitivity analysis- general sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV bus voltage.

Unit- IV Power System Security: Security functions, security level, contingency analysis, security control, economic dispatch using LP formulation, pre-contingency and post- contingency, corrective rescheduling.

Unit -V Stability :Voltage stability, difference between voltage and angle stability, PV curve for voltage stability assessment, proximity and mechanism, modal analysis using reduced jacobian, participation factor, effect of series and shunt compensation on voltage stability , effect of load models.

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## References:

Power Generation, Operation and Control by A.J. wood and B.F. Wollenberg John Wiley & Sons Inc. 1984.

Computer methods in power systems analysis – by stage G.W. and E.L. Abiad A.H. Mc Graw Hill.

Computer Techniques in Power Systems Analysis- Pai M.A. Tata Mc Graw Hill.

Computer Modeling of Electrical Power Systems, Arrillaga J. Arnord C.P Harker B.J. John Wiley & Son

Computer Aided Power Systems Analysis Kusic G.L.- 2nd Edition, CRC Press

Modern Power Systems Analysis Nagrath I.J. and Kothari D.P. Tata Mc Graw Hill.

Power System Analysis Grainger J.J. & Stevenson W.D. Mc Graw Hill.

Power System Stability and control –P Kundur ,IEEE Press 1994.

Advance Power Systems Analysis and Dynamics Singh L.P. John Wiley

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Course Code	DOE-603
Course Title	Elective – II (A Artificial Intelligence)
Number of Credits	4(L:3; T:1; P:0)

## Course Objectives

1. To develop an understanding of intelligent agents and environments, including their types, behaviors, and properties.
2. To provide foundational knowledge of AI methodologies, including search algorithms, fuzzy logic systems, and neural networks, and how these can be applied to problem-solving.

### Course outcomes:

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

**CO1:** Define Artificial Intelligence, describe its goals, and outline its historical evolution and applications in various fields.

**CO2:** Analyze the types and characteristics of intelligent agents and the environments in which they operate.

**CO3:** Apply various search algorithms, including brute-force and heuristic strategies, to solve real-world AI problems.

**CO4:** Explain the working of fuzzy logic systems, including membership functions, fuzzification, and defuzzification processes.

**CO5:** Describe the structure and functioning of neural networks and implement basic models like the perceptron for classification tasks.

### Unit 1 – Introduction to Artificial Intelligence

- Artificial Intelligence (AI) definition
- Goals of AI
- History of AI
- Applications of AI

### Unit 2 – Agents and Environments

- Agent Terminology, Types of Agents – Simple Reflex Agents, Model Based Reflex Agents, Goal Based Agents
- Nature of Environments, Properties of Environments

### Unit 3 – Search Algorithms

Terminology

- Brute Force Search Strategies – Breadth First Search, Depth First Search.
- Heuristic Search Strategies, Local Search Algorithms.

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## **Unit 4 – Fuzzy Logic Systems**

Introduction to Fuzzy Logic and Fuzzy systems,

- Membership functions,
- Fuzzification/Defuzzification

## **Unit 5 – Neural Networks**

Basic structure of Neural Networks

- Perceptron
- Back-propagation

## **Suggested Learning Resources:**

Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases Denis Rothman Packt Publishing ISBN – 978-1788990547

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Course Code	DOE-603
Course Title	Elective – II (B Renewable Energy Technologies)
Number of Credits	4 (L:3; T:1; P:0)

## Course Objectives

Maintain the renewable energy technology equipment.

## Course outcomes:

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

**CO1:** Explain the working principles, construction, and site-specific implications of various ocean energy technologies such as tidal, wave, marine current, and OTEC systems.

**CO2:** Analyze different types of solar energy systems, including PV and concentrated solar power technologies, and evaluate their components, layout, and functioning.

**CO3:** Compare the configurations and components of large wind power plants and differentiate between constant speed and variable speed generator systems.

**CO4:** Illustrate the working of small wind turbines of various types and describe installation methods and suitable electric generators for rooftop and field applications

**CO5:** Evaluate the properties of biomass fuels and describe the layout and functioning of biochemical, thermochemical, and agrochemical biomass-based power plants.

## Unit – I Ocean Energy Technologies

Ocean energy map of India and its implications; Specification, Construction and working of the following ocean energy technologies:

- Tidal power technologies
- Wave power technologies
- Marine current technologies
- Ocean Thermal Energy Conversion (OTEC) technologies

## Unit – II Solar PV and Concentrated Solar Power Plants

- Solar Map of India: Global solar power radiation, Solar PV
- 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

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## Unit – III Large Wind Power Plants

**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- IV Small Wind Turbines

Horizontal Unit- IV Small Wind Turbines

- 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- V Biomass-based Power Plants

- 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.
- 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 a Agro-chemical based (e.g. bio-diesel) power plant.

## Reference Books:

1. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
2. Neill, Simon P.; Hashemi, M. Reza: Fundamentals of Ocean Renewable Energy: Generating Electricity from the Sea, Academic Press, ISBN:978-0-12-810448-4
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, Renewable Energy Systems, Pearson Education New Delhi, ISBN: 9789332586826,
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. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
6. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
7. Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, 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.

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Semester-VI

Course Code	DHS - 604
Course Title	Entrepreneurship and Start-ups
Number of Credits	3 (L:3; T:0; P:0)

## Course Objectives:

1. Acquiring Entrepreneurial spirit and resourcefulness.
2. Familiarization with various uses of human resource for earning dignified means of living.
3. Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
4. Acquiring entrepreneurial quality, competency, and motivation.
5. Learning the process and skills of creation and management of entrepreneurial venture.

## Course Outcome:

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

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning

## Unit 1 - Introduction to Entrepreneurship and Start - Ups

- Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation
- Types of Business Structures, Similarities/differences between entrepreneurs and managers.

## Unit 2 - Business Ideas and their implementation

- Discovering ideas and visualizing the business
- Activity map
- Business Plan

## Unit 3 - Idea to Start-up

- Market Analysis - Identifying the target market,
- Competition evaluation and Strategy Development,
- Marketing and accounting,
- Risk analysis

## Unit 4 - Management

- Company's Organization Structure,
- Recruitment and management of talent.
- Financial organization and management

## Unit 5 - Financing and Protection of Ideas

- Financing methods available for start-ups in India
- Communication of Ideas to potential investors - Investor Pitch
- Patenting and Licenses.

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## **Reference Books:**

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company Steve Blank and Bob Dorf K & S Ranch
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses Eric Ries Penguin UK ISBN – 978-0670921607
3. Demand: Creating What People Love Before They Know They Want It Adrian J . Slywotzky with Karl Weber Headline Book Publishing  
ISBN – 978-0755388974
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business Clayton M. Christensen Harvard business

## **SUGGESTED SOFTWARE/LEARNING WEBSITES:**

- a. <https://www.fundable.com/learn/resources/guides/startup>
- b. <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporatestructure/>
- c. <https://www.finder.com/small-business-finance-tips>
- d. <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>

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Course Code	DEEA - 605
Course Title	Seminar
Number of Credits	1 (L:0; T:0; P:2)

## Course Objectives:

The objective of the seminar is to inculcate self-skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, shall choose preferably a relevant to the Course of Specialization.

Carryout literature survey, organize the seminar content in a systematic manner. Prepare the report with own sentences, avoiding cut and paste act.

Type the matter to acquaint with the use of Micro facilities.

Present the seminar topic orally and/or through power point slides.

Answer the queries and involve in debate/discussion.

Submit typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards.

## Course outcomes:

1 At the end of the course the student become self-Attain,

2 Use and develop knowledge in the field of engineering and other disciplines through independent learning and collaborative study.

3 Identify, understand and discuss current, real Improve oral and written communication skills.

4 Explore an appreciation of the self in relation to its larger diverse social and academic contexts.

5 Apply principles of ethics and respect in interaction with other

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Course Code	DEEA - 606
Course Title	Major Project-II (Project Execution)
Number of Credits	0 (L:2; T:0; P:0)

## Course Outcomes:

Build projects as per industry and society demands.

## Guidelines

1. Students will select an industry-oriented or problem-based project topic.
2. Literature survey and problem identification will be carried out.
3. A project proposal with objectives, block diagram, and cost estimation will be submitted.
4. System design including circuit diagram and component selection will be prepared.
5. Simulation/modeling using suitable software (if required).
6. Procurement of materials and fabrication/assembly of the prototype.
7. Programming and integration of hardware components (if applicable).
8. Testing, troubleshooting, and performance evaluation of the system.
9. Comparison of practical results with theoretical analysis.
10. Preparation of final project report with design, methodology, results, and conclusion.
11. Submission of working model along with presentation and viva-voce.

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Course Code	DEA - 607
Course Title	Indian Constitution
Number of Credits	0 (L:2; T:0; P:0)

## **Unit 1 – The Constitution - Introduction**

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

## **Unit 2 – Union Government**

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

## **Unit 3 – State Government**

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

## **Unit 4 – Local Administration**

- District Administration
- Municipal Corporation
- Zila Panchayat

## **Unit 5 – Election Commission**

- Role and Functioning
- Chief Election Commissioner
- State Election Commission

## **Reference Books:**

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

## **Suggested Software/Learning Websites:**

- a. <https://www.constitution.org/cons/india/const.html>
- b. <http://www.legislative.gov.in/constitution-of-india>
- c. <https://www.sci.gov.in/constitution>
- d. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

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