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 Mechanical Engineering

Semester-VI

Course Code	DMEA-601
Course Title	Design of Machine Elements
Number of Credits	3 (L:3; T:0; P:0)

Course Objectives:

1 To enable the student to design and draw simple machine components used in small and medium scale industries.
2 To understand the basic philosophy and fundamentals of Machine Design.
3 To understand the modes of failures of m/c components and decide the design criteria and equations.
4 To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
5 To develop analytical abilities to give solutions to engineering design problems.

Course outcomes:

At the end of the course, the student will be able to:
CO1 Analyze the various modes of failure of machine components under different load patterns.
CO2 Design and prepare part and assembly drawings.
CO3 Use design data books and different codes of design.
CO4 Select standard components with their specifications from manufacturer's catalogue.
CO5 Develop drawings on CAD software.

UNIT-I: Introduction to Design: Machine Design philosophy and Procedures; General Considerations in Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing; Bending and Torsion; Principal Stresses; Simple Numericals; Creep strain and Creep Curve; Fatigue; S-N curve; Endurance Limit; Factor of Safety and Factors governing selection of factor of Safety; Stress Concentration: Causes & Remedies; Converting actual load or torque into design load or torque using design factors like velocity factor, factor of safety & service factor; Properties of Engineering materials; Designation of materials as per IS and introduction to International standards & advantages of standardization; Use of design data book; Use of standards in design and preferred numbers series; Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

UNIT-II: Design of simple machine parts: Cotter Joint; Knuckle Joint; Turnbuckle; Design of Levers: Hand/Foot Lever & Bell Crank Lever; Design of C–Clamp; Off-set links; Overhang Crank; Arm of Pulley. **Antifriction Bearings**: Classification of Bearings; Sliding contact & Rolling contact; Terminology of Ball bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limiting speed; Selection of ball bearings using manufacturer's catalogue.

UNIT-III: Design of Shafts, Keys, Couplings and Spur Gears: Types of Shafts; Shaft materials; Standard Sizes; Design of Shafts (Hollow and Solid) using strength and rigidity criteria; ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley; Design of Sunk Keys; Effect of Keyways on strength of shaft; Design of Couplings – Muff Coupling, Protected type Flange Coupling, Bush-pin type flexible coupling; Spur gear design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.

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UNIT-IV: Design of Power Screws: Thread Profiles used for power Screws - Relative merits and demerits of each; Torque required to overcome thread friction; Self-locking and overhauling property; Efficiency of power screws; Types of stresses induced; Design of Screw Jack; Toggle Jack.
Design of springs: Classification and Applications of Springs; Spring terminology; Materials and Specifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored in springs; Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Construction and Application.

UNIT-V: Design of Fasteners: Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to eccentric loading; Design of Parallel and Transverse fillet welds; Axially loaded symmetrical section; Merits and demerits of screwed and welded joints.
Ergonomics & Aesthetic consideration in design: Ergonomics of Design: Man–Machine relationship; Design of Equipment for control, environment & safety; Aesthetic considerations regarding shape, size, color & surface finish.

Reference Books:

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-575)
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi (ISBN: 978-9382609-513)
3. Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill control techniques – Applications. Introduction to manufacturing; Fundamental properties of materials including metals, polymers, ceramics and composites.
4. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
5. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
6. Machine design – R.K.Jain, Khanna Publication, New Delhi.
7. Design Data Book – PSG Coimbtore, PSG Coimbtore.
8. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

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Course Code	DMEA-601
Course Title	Design of Machine Elements Lab
Number of Credits	1 (L:0; T:0; P:2)

Course Outcomes For practical

CO1: Understand yield strength, ultimate tensile strength, and fracture point.
CO2: Learn component layout, assembly, and failure modes.
CO3: Apply ASME code and understand shaft design standards.
CO4: Apply design principles for fillet welds and calculate equivalent stresses.
CO5: Gain familiarity with standardization, IS material designation, and preferred size selection.

List Of Experiment

1 Study and Demonstration of Stress-Strain Curve
2 Design and Fabrication of Cotter Joint and Knuckle Joint
3 Design and Analysis of Shaft under Combined Loading
4 Analysis of Welded Joints under Axial and Eccentric Loading
5 Use of Design Data Book and Standards for Component Design

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Department of Mechanical Engineering

Semester-VI

Course Code	DMEA-602
Course Title	Elective IV(A Industrial Robotics & Automation)
Number of Credits	3 (L:3; T:0; P:0)

Course Objectives:

1 To introduce the basic concepts, parts of robots and types of robots.
2 To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
3 To select the robots according to its usage.
4 To discuss about the various applications of robots, justification and implementation of robot.
5 To Conceptualize automation and understand applications of robots in various industries.

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

CO1 Explain the robot anatomy, classification, characteristics of robot , advantages and disadvantages.
CO2 Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
CO3 Explain about various types of sensors and concepts on robot vision system.
CO4 Explain the concepts of robot programming languages and various methods of robot programming.
CO5 Explain the various applications of robots.

UNIT-I: Fundamentals of Robotics: Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.

Unit-II: Robotic Drive System and Controller: Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.

Unit-III: Sensors: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing.

Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving.

Unit-IV: Robot kinematics and Robot Programming: Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands; and Simple programs.

Unit-V: Automation: Basic elements of automated system, advanced automation functions, levels of automation.
Industrial Applications: Application of robots in machining; welding; assembly and material handling.

Reference Books:
1. Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications – M.P. Groover, Tata McGraw Hill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G, Mc-Graw Hill Book Co, 1987.
4. Robotics for Engineers – Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics – Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.
6. Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

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Semester-VI

Course Code	DMEA-602
Course Title	Elective IV (B Production & Operations Management)
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: Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, Establishing the General Characteristics of work piece, determining the principal Process, Functional surfaces of the work piece, Nature of the work to be Performed, Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry of form, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation,Terms used in work piece dimensions, Tolerance stacks. Work piece Control: Introduction, Equilibrium Theories, Concept of location, Geometric Control, Dimensional control, Mechanical control.

UNIT-II: Production Forecasting: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods- Qualitative and Quantitative, Forecast accuracy.

Scheduling:
Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling.

UNIT-III: Break-Even Analysis: Introduction, Break-even analysis charts, Breakeven analysis for process, plant and equipment selection.
Aggregate Operations Planning: Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.

UNIT-IV: Assembly Line Balancing: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, Mixed model line balancing, Current thoughts on assembly lines, Computerized assembly line balancing.

UNIT-V: Material Management: Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating.

Reference Books:

1. Production and Operations Management – K.Aswathappa, K.Shridhara Bhat, Himalaya Publishing House, 2014.
2. Production and Operations Management – Shailendra Kale, McGraw Hill Educations(India) Private Limited,2013.
3. Production and Operations Management – R.Paneerselvam, PHI Learning Private Limited, 2013.
4. Operations Management – Joseph Monk, TMH Publishers, New Delhi, 2004.
5. Modern Production /Operations Management – Buffa Elwood S, John Wiley Publishers, Singapore, 2002.

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Semester-VI

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.

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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Semester-VI

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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Undergraduate Diploma Courses in Engineering & Technology

Department of Mechanical Engineering

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.

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	DMEA - 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	DMEA - 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

Students shall execute the project planned in Phase I through fabrication, modeling, or simulation. The focus is on applying practical knowledge to build a working prototype or system. Activities include material procurement, assembly, testing, troubleshooting, and performance evaluation. A final report with design, methodology, results, and conclusion must be submitted along with a presentation and viva. Team coordination, innovation, and technical documentation are essential assessment criteria.

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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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