



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**Course Structure for Mechanical Engineering  
B. Tech Course  
(2013-14)**

**IV B. Tech – II Sem**

| S. No | Course Code                      | Subject  | Theory    | Tu        | Lab       | Credits   |
|-------|----------------------------------|--|-----------|-----------|-----------|-----------|
| 1     | 13A03801<br>13A03802<br>13A03803 | MOOCS I<br>a. Industrial Engineering<br>b. Entrepreneurship<br>c. Composite Materials                | 3         | 1         | -         | 3         |
| 2     | 13A03804<br>13A03805<br>13A03806 | MOOCS II<br>a. Power Plant Engineering<br>b. Gas Turbines and Jet Propulsion<br>c. Energy Management | 3         | 1         | -         | 3         |
| 3     | 13A03807<br>13A03808<br>13A03809 | MOOCS III<br>a. Modern Manufacturing Methods<br>b. Rapid Proto Typing<br>c. Product Design           | 3         | 1         | -         | 3         |
| 4     | 13A03810                         | Technical Seminar  | -         | -         | 4         | 2         |
| 5     | 13A03811                         | Project work   | -         | -         | 24        | 12        |
|       |                                  | <b>Total</b>   | <b>09</b> | <b>03</b> | <b>28</b> | <b>23</b> |

**3 Theory + 1 Technical Seminar + 1 Project work**

**\*Either by MOOCS manner or Self study or Conventional manner**

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**(13A03801) INDUSTRIAL ENGINEERING**

**(MOOC I)**

*Course Objective:*

*To make the students understand the concepts of Industry Practices, to able to identify the requirements for establishing a plant, to understand the production process and work metrics and to understand the types of inventories and managing the inventory for better profitability and also to understand the management concepts.*

**UNIT I**

Concepts of Management-Administration and Organization – Functions of Management – Schools of

Management Thought: Taylor’s Scientific Management, Fayol’s Principles of Management, Douglas

Mc-Gregor’s Theory X and Y, Mayo's Hawthorne Experiments, Herzberg’s Two factor Theory of

Motivation, Maslow’s Hierarchy of Human needs – Systems Approach to Management.

Organizational Structures- Functional- Divisional- Matrix etc., Basic Concepts Related to Organization – Departmentation and Decentralization and their Merits, Demerits and Suitability

**UNIT II**

Plant Location: Definition, Factors affecting the Plant Location, Comparison of Rural and Urban sites,

Selection of Plant Location – Types of Production; Plant Layout: Definition, Objectives, Types of Plant Layout - Materials Handling: Functions- Objectives – Types, Selection Criteria of Material Handling Equipment.

**UNIT III**

Work Study – Definition, Objectives, Method Study – Steps Involved – Various Types of Process Charts –Micro motion and Memo motion Studies.

Work Measurement - Definition, Time Study, Steps involved - Equipment, Different Methods of

Performance Rating - Allowances, Standard Time Calculation. Work Sampling - Definition, Steps

Involved, Standard Time Calculations - Applications.

#### **UNIT IV**

Inventory Models- Deterministic models- EOQ Models – With and Without Shortages Models; Inventory Models with Price Breaks -Probabilistic Models –Discrete Variable, Continuous Variable. Inventory Control Systems

#### **UNIT V**

Inspection & Quality Control: Statistical Quality Control- Techniques-Variables and Attributes- Control Charts: X and R Charts; P Charts and C Charts. Acceptance Sampling Plan - Single Sampling and Double Sampling Plans- OC Curves. Introduction to TQM- Quality circles-BIS & ISO Standards-Importance .

#### **Text Books:**

1. Manufacturing Organization and Management, T.Amrine/ Pearson, 2nd Edition, 2004
2. Industrial Engineering and Management ,O.P.Khanna, DhanpatiRai, 18th edition, 2013.
3. Industrial Engineering and Management, Dr. C.Nadamuni Reddy, New Age International Publishers, 1<sup>st</sup> edition, 2011.

#### **Reference Books:**

1. *Industrial Engineering and production management, MartindTelsang S.Chand.2015*
2. *Industrial Organisation and Engineering Economics, T.R.Banga, S.C.Sharma, Khanna,2015*
3. *Management by James AF Stoner, Freeman 6th Ed, Pearson Education, New Delhi,2015*
4. *Production and Operations management, PanneerSelvam, PHI,2004.*
5. *Statistical Quality Control by EL Grantt, McGrawhil, 2014*
6. *Motion and time studies by Ralph M Barnes, John Wiley and Sons,2004*

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**(13A03802) ENTREPRENEURSHIP**

**(MOOC I)**

*Course Objective:*

*To make the students understand the concepts of entrepreneurship. To understand type of idea generation to start an enterprise, To understand the concepts of ventures, business plans, marketing plans, sources of capital, New venture setup and expansion strategies and sales and promotional aspects of a product etc.,*

**UNIT 1:** Introduction to Entrepreneurship Definition Types of Entrepreneur, Entrepreneurial Traits, Entrepreneur vs. Manager, Entrepreneur vs Intrapreneur. The Entrepreneurial decision process. Ethics and Social responsibility of Entrepreneurs. Opportunities for Entrepreneurs in India and abroad.

Creating and Starting the Venture, Sources of new Ideas, Methods of generating ideas, creative problem solving, product planning and development process.

**UNIT II:** The Business Plan Nature and scope of Business plan, Writing Business Plan, Evaluating Business plans, Using and implementing business plans. Marketing plan, financial plan and the organizational plan, Launching formalities.

**UNIT III:** Financing and Managing the new venture, Sources of capital, venture capital , angel investment, Record keeping, recruitment, motivating and leading teams, financial controls. Marketing and sales controls. E-commerce and Entrepreneurship, Internet advertising.

**UNIT IV:** New venture Expansion Strategies and Issues, Features and evaluation of joint ventures, acquisitions, merges, franchising. Public issues, rights issues, bonus issues and stock splits.Choosing location and layout, Issues related to Selection of layout.

**UNIT V:** Production and Marketing Management Thrust of production management, Selection of production Techniques, plant utilization and maintenance, Designing the work place, Inventory control, material handling and quality control.Marketing functions, market segmentation, market research and channels of distribution, Sales promotion and product pricing. Global aspects of Enterprenership.

**Text Books:**

1. Entrepreneurship, Robert Hisrich, & Michael Peters, TMH, 5th Edition
2. Entrepreneurship, Dollinger, Pearson, 4/e 2004.

**REFERENCES:**

1. Dynamics of Entrepreneurial Development and management, Vasant Desai, Himalaya Publishing House, 2004.
2. Harvard Business Review on Entrepreneurship. HBR Paper Back, 1999.
3. Entrepreneurial Management, . Robert J. Calvin., TMH, 2004.

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**(15A03803) COMPOSITE MATERIALS**

**(MOOC I)**

*Course Objective:*

*To make the students aware of various composite materials available, the structure of composites, to learn about manufacturing methods, to analyze the macro mechanical stress and strain, micromechanical analysis of Lamina, To understand the failure analysis of material*

**Introduction to Composite Materials:** Introduction, Classification: Polymer Matrix Composites. Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber. Reinforced Composites and nature-made composites, and applications

**Reinforcements:** Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and boron carbide. fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

**Unit-II**

**Manufacturing methods:** Autoclave curing, tape production, moulding methods, filament winding, hand layup, pultrusion, RTM. Compression moulding, tape winding.

**Macromechanical Analysis of a Lamina:** Introduction ,Definitions: Stress, Strain ,Elastic Moduli, Strain Energy. Hooke’s Law for Different Types of Materials, Plane Stress Assumption, Reduction of Hooke’s Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

**Unit-III**

**Micromechanical Analysis of a Lamina:** Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion

## **UNIT-IV**

**Macromechanical Analysis of Laminates:** Introduction, Laminate Code, Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates

## **UNIT-V**

**Failure Analysis and Design of Laminates:** Introduction, Special Cases of Laminates, Failure Criterion for a Laminate.

### **Text Books:**

1. Engineering Mechanics of Composite Materials- Isaac and M Daniel, Oxford University Press, 1994.
2. Mechanics of Composite Materials, R. M. Jones, Mc Graw Hill Company, New York, 1975.

### **References:**

1. Analysis and performance of fibre Composites, B. D. Agarwal and L. J. Broutman Wiley- Interscience, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering)- Autar K. Kaw, Publisher: CRC
3. Finite Element Analysis of Composite Materials, Ever J. Barbero , CRC Press, 2007.
4. Analysis of Laminated Composite Structures, L. R. Calcote, Van Nostrand Rainfold, New York, 1969.
5. Mechanics of Composite Materials and Structures, Madhujit Mukhopadhyay, University Press, 2009.
6. Composite Materials Science and Engineering, Krishan K. Chawla, Springer, 2009

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**(13A03804) POWER PLANT ENGINEERING**  
**(MOOC II)**

*Course Objective:*

*To make the students understand the importance of energy and constructional features and procedure of various types of power plants.*

**UNIT I**

Introduction To The Sources Of Energy – Resources and Development of Power in India.

Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power

Cycles - Comparison and Selection,

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges,

Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve.

Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor,

Diversity Factor – Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment –

Pollutants and Pollution Standards – Methods of Pollution Control. Inspection And Safety Regulations.

**UNIT II**

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant : Combustion Process : Properties of Coal – Overfeed and Under Feed Fuel Beds,

Traveling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its

Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders

### **UNIT III**

Diesel Power Plant: Diesel Power Plant: Introduction – IC Engines, Types, Construction– Plant Layout with Auxiliaries – Fuel Storage

Gas Turbine Plant : Introduction – Classification - Construction – Layout With Auxiliaries – Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

### **UNIT IV**

Hydro Electric Power Plant: Water Power – Hydrological Cycle / Flow Measurement – Drainage Area Characteristics – Hydrographs – Storage and Pondage – Classification of Dams and Spill Ways.

Hydro Projects and Plant: Classification – Typical Layouts – Plant Auxiliaries – Plant Operation Pumped Storage Plants. .

### **UNIT V**

Power from Non-Conventional Sources: Utilization of Solar Collectors- Principle Of its Working, Wind Energy – Types of Turbines – HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel – Nuclear Fission, Chain Reaction, Breeding and Fertile Materials – Nuclear Reactor –Reactor Operation.

Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast

breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding –

Radioactive Waste Disposal.

***Text Books:***

- 1. Power plant Engineering, P.K. Nag, TMH, 3rd edition, 2013.*
- 2. A course in power plant Engineering, Arora and S. Domkundwar.*

***Reference Books:***

- 1. A Text Book of Power Plant Engineering , Rajput , Laxmi Publications, 4th edition, 2012.*
- 2. Power plant Engineering, Ramalingam, Scietech Publishers*
- 3. power plant engineering P.C. Sharma, S.K. Kataria Publications,2012.*

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**(13A03805) GAS TURBINES AND JET PROPULSION**

**(MOOC II)**

*Course Objective:*

*To make the students understand the working principles of Gas Turbines and concepts of Jet Propulsions.*

**UNIT-I**

Gas Turbine Operating Cycles: Simple open cycle gas turbine or air standard Brayton cycle, Actual Brayton cycle, the cycle air flow rate, the cycle work ratio, optimum pressure ratio or maximum cycle thermal efficiency, means of improving the efficiency and the specific output of simple cycle.

**UNIT-II**

Gas Turbines; gas turbine applications, gas turbine advantages & disadvantages, energy flow & back work, deviation from ideal cycle, gas turbine with regeneration, thermal efficiency of gas turbine with & without regenerator, gas turbine engines, inter-cooling & reheating, turbojet engine, turbofan engine, turboprop engine.

**UNIT-III**

**Jet propulsion:** Historical sketch- reaction principle- essential features of propulsion devices- Thermal jet engines, classification of – energy flow, thrust, thrust power and propulsion efficiency- need for thermal jet engines and applications.

Turboprop and turbojet – thermodynamic cycles, plant layout, essential components, and principles of operation – performance evaluation – thrust augmentation and Thrust reversal – contrasting with piston engine propeller plant.

## **UNIT-IV**

Ram jet- Thermo dynamic cycle, plant lay out, essential components – principle of operation – performance evaluation – comparison among atmospheric thermal jet engines- serqujet and pulse jet, elementary treatment.

**Rocket Engines:** Need for, applications- basic principle of operation and parameters of performance – classification, solid and liquid propellant rocket engines, advantages, domains of application – propellants – comparison of propulsion systems.

## **UNIT-V**

**Rocket Technology:** Flight mechanics, application thrust profiles, acceleration- staging of rockets, need for – feed systems, injectors and expansion nozzles – rocket transfer and ablative cooling.

Testing & instrumentation - need for Cryogenics – advanced propulsion systems, elementary treatment of Electrical nuclear and plasma Arc Propulsion.

### **TEXT BOOKS:**

1. Gas Turbines , V. Ganesan TMGH
2. Gas turbines , cohen , Rogers & Sarvana Muttoo , Addison Wiley & longman

### **REFERENCES BOOK:**

1. Thermodynamics of propulsion, Hill & Paterson.
2. Rocket Propulsion , Sutton.
3. Element of Gas Turbines propulsion , Jack D Matingly, MGH

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**(13A03806) ENERGY MANAGEMENT**

**(MOOC II)**

*Course Objective:*

*To make the students understand managerial economics of energy projects, to study about depreciation and cost analysis and methods of investment analysis. To understand the energy auditing concepts.*

**UNIT - I**

**ENGINEERING ECONOMICS:**

Managerial objectives - steps in planning- Capital budgeting- Classification of costs- Interest- Types- Nominal and effective interest rates Discrete and continuous compounding - discounting - Time value of money - Cash flow diagrams - Present worth factor, Capital recovery factor, Equal annual payments - Equivalence between cash flows.

**UNIT - II**

**DEPRECIATION & COST ANALYSIS:**

Aims-Physical depreciation-Functional depreciation- Methods of depreciation-Straight line method, Declining balance method, Sum of years digits method, Sinking fund method, Service output method- Capital recovery with return-Service life estimation- Morality curves. Break even analysis and break even chart- Minimum cost analysis- Benefit cost analysis- Life cycle cost analysis.

**UNIT - III**

**PROJECT MANAGEMENT:**

Methods of investment appraisal- Rate of return method, Payback period method, Net present value method (NPV)- Internal Rate of Return method(IRR)- Adoption of the methods in energy conservation campaign- Types of projects- Purpose of project management - Classification – Role and qualities of project manager - Types of budgets - Budget committee – budgeting.

**ENERGY MANAGEMENT PROGRAMS:**

Necessary steps of energy management programmer - Concepts of Energy management - General principles of energy management – Energy management in manufacturing and process industries- Qualities and functions of Energy manager - Language of Energy manager-Checklist for top management.

#### **UNIT - IV**

##### **ENERGY AUDITING:**

A definition- Objectives- Level of responsibility- Control of Energy- Uses of Energy checklists - Energy conservation- Energy index - Cost index - Pie charts-sankey diagrams Load profiles - Types of energy audits- Questionnaire - Energy audit of industries - General energy audit- Detailed energy audit - Energy saving potential.

#### **UNIT - V**

##### **ENERGY POLICY, SUPPLY, TRADE& PRICES:**

Energy resources in India – level of power generation – transmission & distribution of power. Indian energy policy,Energy trade & its economic impacts – domestic energy production – Energy transformation & distribution & energy self sufficiency. International & National crude oil prices – domestic fuel prices – natural gas, LPG, kerosene and firewood - pricing policy.

##### **BOOKS:**

1. Albert Thumann, Handbook of Energy Audits, The Fairmont Press Inc., Atlanta gorgia, 1979.
2. Murphy W.R and Mckay G, Energy Management, Butterworths, London, 1982.
3. Albert Thumann, Plant Engineer and Management guide to Energy Conservation, Van Nost and Reinhold Co., Newyork.
4. Energy Audits, E.E.O.-Book-lets, U.K. 1988.
5. Craig B.Smith, “Energy Management Principles”, Pergamon Press.
6. The role of Energy Manager, E.E.O., U.K.
7. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
8. Energy Management Hand Book-Ed. By Wayne C. Turner, John Wiley and sons, 1982.

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**(13A03807) MODERN MANUFACTURING METHODS**

**(MOOC III)**

**UNIT I**

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping

methods - their relevance for precision and lean manufacturing.

Classification of non-traditional processes - their selection for processing of different materials and the range of applications.

Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

**UNIT II**

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters,

applications and limitations.

Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal,

descriptive of equipment, process variables, applications and limitations.

**UNIT III**

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.

Chemical Machining: Fundamentals of chemical machining- Principle of material removal-maskants – etchants- process variables, advantages and applications.

## **UNIT IV**

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy -

Applications of different processes and their limitations.

Plasma Machining: Principle of material removal, description of process and equipment, process

variables, scope of applications and the process limitations.

## **UNIT V**

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron

beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters,

applications and limitations.

Laser Beam Machining: Process description, Mechanism of material removal, process parameters,

capabilities and limitations, features of machining, applications and limitations.

### ***Text Books:***

*1. Advanced machining processes, VK Jain, Allied publishers.*

*2. Manufacturing processes for engineering materials by Serope Kalpakjian and Steven R Schmid,*

*5edn, Pearson Pub.*

***Reference Books:***

- 1. New Technology , Bhattacharya A, The Institution of Engineers, India 1984*
- 2. Manufacturing Technology, Kalpakzian, Pearson*
- 3. Modern Machining Process , Pandey P.C. and Shah H.S., TMH.*

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**(13A03808) RAPID PROTOTYPING**

**(MOOC III)**

**Unit-I Introduction:** Need for the compression in product development, History of RP system,

Survey of applications, Growth of RP industry and classification of RP system.

**Stereo Lithography System:** Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

**Unit II Fusion Decomposition Modeling:** Principle, process parameter, Path generation, Applications. **Solid ground curing:** Principle of operation, Machine details, Applications, **Laminated Object Manufacturing:** Principle of Operation, LOM materials, Process details, Applications.

**Unit –III Concepts Modelers:** Principle, Thermal jet printer, Sander’s model market, 3-D printer, GenisysXs printer HP system 5, Object Quadra system.

**Unit –IV LASER ENGINEERING NET SHAPING (LENS)**

**Rapid Tooling:** Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling

Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast

process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

**Software for RP:** STL files, Overview of Solid view, magics, imics, magic communication, etc.

Internet based software, Collaboration tools.

**Unit V Rapid Manufacturing Process Optimization:** Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

**Allied Process:** Vacuum casting, surface digitizing, Surface generation from point cloud, Surface modification- Data transfer to solid models.

**TEXT BOOKS:**

1. “ stereo lithography and other RP & M Technologies”, Paul F.Jacobs, SME, NY 1996
  2. “ Rapid Manufacturing ”, Flham D.T &Dinjoy S.S, Verlog London 2001
- “Rapid automated”, Lament wood, Indus Press New York.

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**(13A03809) PRODUCT DESIGN**

**(MOOC III)**

*Course Objective:*

*To make the students understand the product development process, requirements setting, conception design,, embodiment design principles, to understand the basics of mechatronics and adaptronics.*

**UNIT I**

**PRODUCT DEVELOPMENT PROCESS**

General problem solving process - Flow of Work during the process of designing - Activity Planning Timing and scheduling, Planning Project and Product Costs - Effective Organization Structures - Interdisciplinary Cooperation, Leadership and Team behavior.

**UNIT II**

**TASK CLARIFICATION**

Importance of Task Clarification - Setting up a requirements list - Contents, Format, Identifying the requirements, refining and Extending the requirements, Compiling the requirements list, Examples.

Using requirements lists - Updating, Partial requirements lists, Further uses - Practical applications of requirements lists.

**UNIT III**

**CONCEPTUAL DESIGN**

Steps in Conceptual Design.

Abstracting to identify the essential problems - Aim of Abstraction, Broadening the problem. Formulation, Identifying the essential problems from the requirements list, Establishing functions structures, Overall function, Breaking a function down into sub-functions.

Developing working structures - Searching for working principles, Combining Working Principles, Selecting Working Structures, Practical Application of working structures.

Developing Concepts - Firming up into principle solution variants, Evaluating principle solution variants, Practical Applications of working structures.

Examples of Conceptual Design - One Handed Household Water Mixing Tap, Impulse - Loading Test Rig.

**UNIT IV**

**EMBODIMENT DESIGN** - Steps of Embodiment Design, Checklist for Embodiment Design  
Basic rules of Embodiment Design

Principles of Embodiment Design - Principles of Force Transformations, Principles of Division of Tasks, Principles of Self-Help, Principles of Stability and Bi-Stability, Principles of Fault-Free Design

Guide for Embodiment Design - General Considerations, Design to allow for expansion, Design to allow for creep and relaxation, Design against Corrosion, Design to minimize wear, Design to Ergonomics, Design for Aesthetics, Design for Production, Design for Assembly, Design for Maintenance, Design for Recycling, Design for Minimum risk, Design to standards.

Evaluation of Embodiment Designs.

**UNIT V**

**MECHANICAL CONNECTIONS, MECHATRONICS AND ADAPTRONICS**

Mechanical Connections - General functions and General Behavior, Material connections, From Connections, Force connections, Applications.

Mechatronics - General Architecture and Terminology, Goals and Limitations, Development of Mechatronic Solution, Examples.

Adaptronics - Fundamentals and Terminology, Goals and Limitations, Development of Adaptronics Solutions, Examples.

***Text Books:***

*1. Engineering Design: G.Paul; W. Beitzetal, Springer International Education 2010.*

*2. Product Design And Development: Kevin Otto: K. Wood Pearson Education 2016.*

***Reference Books:***

*1. Product Planning Essentials: Kenith B. Kahu, Yes dee Publishing 2011.*

*2. Product Design and Development: K.T. Ulrich TMH Publishers 2011.*