J. S. University, Shikohabad

# B.Tech

7th Semester& 8thSemester

(Mechanical Engineering)

*Scheme*

*&*

*Syllabus*

[Effective from the session 2024-25]

**STUDY AND EVALUATION SCHEME FOR**
**B.TECH. (MECHANICAL ENGINEERING)**

## SEMESTER -VII

| S.No. | Subject Code | Name of Subject | Periods Per Week | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr. | Sessional | End Exam | Total | Duration |
| **THEORY SUBJECT** | | | | | | | | | | |
| 1 | BTME-701 | HSMC-1/HSMC-2 | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| 2 | BTME-702 | Departmental Elective-IV | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| 3 | BTME-703 | Departmental Elective-V | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| 4 | BTME-704 | Open Elective-II | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| **PRACTICAL / PROJECT SUBJECTS** | | | | | | | | | | |
| 5 | BTME-751P | Measurement & Metrology Lab | 0 | 0 | 2 | 1 | 25 | 25 | 50 | 3 |
| 6 | BTME-752P | Mini Project or Internship Assessment* | 0 | 0 | 2 | 1 | 50 | | 50 | 3 |
| 7 | BTME-753P | Project | 0 | 0 | 8 | 4 | 150 | | 150 | 3 |
| | | | | | | **18** | Grand Total | | **850** | |

***The Mini Project or Summer Internship (4weeks) / NPTEL Course (4-week) conducted during summer break after VI semester and same will be assessed / evaluated in the Semester-VII.

### HUMANITIES, SCOCIAL SCIENCE AND MANAGEMENT COURSE (HSMC COURSE) HSMC1/HSMC2

| | |
|---|---|
| **BTME-701** | RURAL DEVELOPMENT: ADMINISTRATION AND PLANNING |
| | PROJECT MANAGEMENT & ENTREPRENEURSHIP |

### LIST OF DEPARTMENTAL ELECTIVE-IV FOR B. TECH. COURSES

| | |
|---|---|
| **BTME-702** | ADDITIVE MANUFACTURING |
| | HVAC SYSTEMS |
| | HYBRID VEHICLE PROPULSION |

### LIST OF DEPARTMENTAL ELECTIVE-V FOR B. TECH. COURSES

| | |
|---|---|
| **BTME-703** | MATHEMATICAL MODELING OF MANUFACTURING PROCESSES |
| | MACHINE LEARNING |
| | COMPUTER GRAPHICS AND PRODUCT MODELING |
| | POWER PLANT ENGINEERING |
| | VEHICLE BODY ENGINEERING & SAFETY |

### LIST OF OPEN ELECTIVES-II FOR B. TECH. COURSES

| | |
|---|---|
| **BTME-704** | FILTER DESIGN |
| | BIOECONOMICS |
| | MACHINE LEARNING |
| | RENEWABLE ENERGY RESOURCES |
| | OPERATIONS RESEARCH |
| | VISION FOR HUMANE SOCIETY |
| | DESIGN THINKING |
| | SOIL AND WATER CONSERVATION ENGINEERING |
| | INTRODUCTION TO WOMEN'S AND GENDER STUDIES |

**STUDY AND EVALUATION SCHEME FOR**
**B.TECH. (MECHANICAL ENGINEERING)**

## SEMESTER -VIII

| S.No. | Subject Code | Name of Subject | Periods Per Week | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Cr. | Sessional | End Exam | Total | Duration |
| **THEORY SUBJECT** | | | | | | | | | | |
| 1 | BTME-801 | HSMC-2/HSMC-1 | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| 2 | BTME-802 | Open Elective-III | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| 3 | BTME-803 | Open Elective-IV | 3 | 0 | 0 | 3 | 50 | 100 | 150 | 3 |
| **PRACTICAL / PROJECT SUBJECTS** | | | | | | | | | | |
| 4 | BTME-851P | Project | 0 | 0 | 18 | 9 | 100 | 300 | 400 | 3 |
| | | | | | | **18** | | Grand Total | **850** | |

## HUMANITIES, SCOCIAL SCIENCE AND MANAGEMENT COURSE (HSMC COURSE) HSMC1/HSMC2

| | |
|---|---|
| **BTME-801** | RURAL DEVELOPMENT: ADMINISTRATION AND PLANNING |
| | PROJECT MANAGEMENT & ENTREPRENEURSHIP |

## LIST OF OPEN ELECTIVES-III FOR B. TECH. COURSES

| | |
|---|---|
| **BTME-802** | FUNDAMENTALS OF DRONE TECHNOLOGY |
| | CLOUD COMPUTING |
| | BIO MEDICAL SIGNAL PROCESSING |
| | ENTREPRENEURSHIP DEVELOPMENT |
| | INTRODUCTION TO SMART GRID |
| | QUALITY MANAGEMENT |
| | INDUSTRIAL OPTIMIZATION TECHNIQUES |
| | VIROLOGY |
| | NATURAL LANGUAGE PROCESSING |
| | **HUMAN VALUES IN MADHYASTH DARSHAN |

** It is mandatory that for these subjects only Trained Faculty (who had done the FDP for these courses) will teach the courses.

## LIST OF OPEN ELECTIVES-IV FOR B. TECH. COURSES

| | |
|---|---|
| **BTME-803** | ELECTRIC VEHICLES |
| | AUTOMATION AND ROBOTICS |
| | COMPUTERIZED PROCESS CONTROL |
| | DATA WAREHOUSING & DATA MINING |
| | DIGITAL AND SOCIAL MEDIA MARKETING |
| | MODELING OF FIELD-EFFECT NANO DEVICES |
| | MODELLING AND SIMULATION OF DYNAMIC SYSTEMS |
| | BIG DATA |
| | **HUMAN VALUES IN BUDDHA AND JAIN DARSHAN |
| | **HUMAN VALUES IN VEDIC DARSANA |

** It is mandatory that for these subjects only Trained Faculty (who had done the FDP for these courses) will teach the courses.

## Semester – VII / VIII : HSMC COURSE-1

| Subject Code | RURAL DEVELOPMENT: ADMINISTRATION AND PLANNING | L:T:P | Credits |
|---|---|---|---|
| BTME-701/ BTME-801 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand basic concepts and principles of rural development. |
| **2.** | Analyze the structure, functions, and challenges of rural administration. |
| **3.** | Learn about the switched capacitor filter. |
| **4.** | Evaluate rural development policies and their effectiveness. |
| **5.** | Explore the role and functioning of rural institutions. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO-1** | understand the definitions, concepts and components of Rural Development |
| **CO-2** | know the importance, structure, significance, resources of Indian rural economy. |
| **CO-3** | Students will have a clear idea about the area development programmes and its impact. |
| **CO-4** | acquire knowledge about rural entrepreneurship. |
| **CO-5** | understand about the using of different methods for human resource planning |

### UNIT – I

### Rural Planning & Development:

Concepts of Rural Development, Basic elements of rural Development, and Importance of Rural Development for creation of Sustainable Livelihoods, An overview of Policies and Programmes for Rural Development-Programmes in the agricultural sector, Programmes in the Social Security, Programmes in area of Social Sector.

### UNIT-II

### Rural Development Programmes:

Sriniketan experiment, Gurgaon experiment, marthandam experiment, Baroda experiment, Firkha development scheme, Etawa pilot project, Nilokheri experiment,approaches to rural community development: Tagore, Gandhi.

### UNIT-III

### Panchayati Raj & Rural Administration:

Administrative Structure: 8 bureaucracy, structure of administration; Panchayati Raj Institutions Emergence and Growth of Panchayati Raj Institutions in India; People and Panchayati Raj; Financial Organizations in Panchayati Raj Institutions, Structure of rural finance, Government & Non-Government Organizations / Community Based Organizations, Concept of Self-help group.

### UNIT-IV

### Human Resource Development in Rural Sector:

Need for Human Resource Development, Elements of Human Resource Development in Rural Sector Dimensions of HRD for rural development-Health, Education, Energy, Skill Development, Training, Nutritional Status access to basic amenities – Population composition.

### UNIT-V

### Rural Industrialization and Entrepreneurship:

Concept of Rural Industrialization, Gandhi an approach to Rural Industrialization, Appropriate Technology for Rural Industries, Entrepreneurship and Rural Industrialization- Problems and diagnosis of Rural Entrepreneurship in India, with special reference to Women Entrepreneurship; Development of Small Entrepreneurs in India, need for and scope of entrepreneurship in Rural area.

**Books and References:**


1. Corporate Social Responsibility: An Ethical Approach - Mark S. Schwartz
2. Katar Singh: Rural Development in India – Theory History and Policy
3. TodaroM.P. Economic Development in III World war
4. Arora R.C – Integrated Rural Development in India
5. Dhandekar V.M and Rath N poverty in India
6. A.N.Agarwal and KundanaLal: Rural Economy of India
7. B.K.Prasad: Rural Development-Sarup& Son's Publications.

**Semester – VII / VIII : HSMC COURSE-2**

| Subject Code | PROJECT MANAGEMENT & ENTREPRENEURSHIP | L:T:P | Credits |
|---|---|---|---|
| BTME-702/ BTME-802 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop knowledge of project management and its principles. |
| **2.** | Analyze the different stages of a project's life cycle. |
| **3.** | Explore entrepreneurship and its key concepts. |
| **4.** | Understand the steps involved in starting a new business. |
| **5.** | Develop skills in managing and leading a successful project. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO-1** | understand the Need, scope and conceptual model of entrepreneurship |
| **CO-2** | Know the Entrepreneurial Idea Generation and Identifying Business Opportunities. |
| **CO-3** | understand the Project Management and Project life-cycle Project appraisal |
| **CO-4** | Understand about the Preparation of detailed project report, Project finance. |
| **CO-5** | Understand about the Social Entrepreneurship Opportunities. |

**UNIT – I**

**Entrepreneurship:**

Need, scope, Entrepreneurial competencies & traits, Factors affecting entrepreneurial development, Entrepreneurial motivation (Mc Clellend's Achievement motivation theory), conceptual model of entrepreneurship , entrepreneur vs. intrapreneur; Classification of entrepreneurs; Entrepreneurial Development Programmes.

**UNIT-II**

**Entrepreneurial Idea and Innovation:**

Introduction to Innovation, Entrepreneurial Idea Generation and Identifying Business Opportunities, Management skills for Entrepreneurs and managing for Value Creation, Creating and Sustaining Enterprising Model & Organizational Effectiveness.

**UNIT-III**

**Project Management:**

Meaning, scope & importance, role of project manager;

**Project life-cycle Project appraisal:**

Preparation of a real time project feasibility report containing Technical appraisal,; Environmental appraisal, Market appraisal (including market survey for forecasting future demand and sales) and Managerial appraisal.

**UNIT-IV**

**Project Financing:**

Project cost estimation & working capital requirements, sources of funds, capital budgeting, Risk & uncertainty in project evaluation , preparation of projected financial statements viz. Projected balance sheet, projected income statement, projected funds & cash flow statements, Preparation of detailed project report, Project finance.

**UNIT-V**

**Social Entrepreneurship:**

Social Sector Perspectives and Social Entrepreneurship, Social Entrepreneurship Opportunities and Successful Models, Social Innovations and Sustainability, Marketing Management for Social Ventures, Risk Management in Social Enterprises, Legal Framework for Social Ventures.

**Books and References:**


1. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
2. Business, Entrepreneurship and Management: Rao, V.S.P. ;Vikas
3. Entrepreneurship: Roy Rajeev; OUP.
4. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan
5. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI
6. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.; MGH

## Semester – VII : PRACTICAL SUBJECTS

| Subject Code | MEASUREMENT & METROLOGY LAB | L:T:P | Credits: 3 |
|---|---|---|---|
| BTME-751P | | 0:0:2 | 01 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop skills in using measuring instruments and gauges. |
| **2.** | Understand the principles of measurement and metrology. |
| **3.** | Learn the calibration techniques for measuring instruments. |
| **4.** | Develop skills in precision measurements and analysis. |
| **5.** | Explore the different types of measurement errors and their correction. |

| **Course Outcome(CO):**The Students will be able to | |
|---|---|
| **CO-1** | Understand the basic principles of instrumentation for measurement of surface finish, strain,temperature, pressure and flow. |
| **CO-2** | Understand the principle and operation of Coordinate Measuring Machine (CMM). |
| **CO-3** | Apply Sine Bar, Slip Gauges, Bevel Protractor, Stroboscope, Dial Indicator etc. for Measurement of different attributes. |
| **CO-4** | Apply the basic concepts of limits, fits & tolerances for selective assembly. |

### List of Experiments

Minimum 08 experiments out of following (or such experiment) are to be performed:

**1.** Measurementofeffectivediameterofascrewthreadusing3wiremethod.

**2.** Measurement of angle using sine bar & slip gauges.

**3.** Study of limit gauges.

**4.** Study & angular measurement using Bevel protector.

**5.** Study of different types of Comparators.

**6.** Study of important parameters of surface finish.

**7.** Study of principle and operation of coordinate-measuring machine (CMM).

**8.** Use of dial indicator and V Block to check the circularity and plot the polar Graph.

**9.** Study and understanding of limits, fits & tolerances in assembly of machine components.

**10.** Study and understanding of different methods of measurement of pressure.

**11.** Study and understanding of different methods of measurement of temperature.

**12.** Study and understanding of measurement of strain using strain gauges.

**13.** Study and understanding of different methods of measurement of flow.

**14.** Study and understanding of different methods of measurement of vibration/ power.

**15.** Study and understanding of measurement of displacement using LVDT.

## Semester – VII : Departmental Elective – IV

| Subject Code | ADDITIVE MANUFACTURING | L:T:P | Credits |
|---|---|---|---|
| BTME-702 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the principles and applications of additive manufacturing. |
| **2.** | Learn the different types of additive manufacturing processes. |
| **3.** | Develop skills in designing parts for additive manufacturing. |
| **4.** | Explore the materials used in additive manufacturing. |
| **5.** | Analyze the challenges and opportunities of additive manufacturing. |

| **Course Outcome:** Student will be able to | |
|---|---|
| **CO1** | Understanding the basics of additive manufacturing/rapid prototyping and its Advantages and disadvantages |
| **CO2** | Understanding the role of additive manufacturing in the design process and the implications for design. |
| **CO3** | Understanding the processes used in additive manufacturing for a range of materials and applications |
| **CO4** | Understand the various software tools, processes and techniques that enable advanced/ additive manufacturing and personal fabrication. |
| **CO5** | Apply knowledge of additive manufacturing for various real-life applications |

**UNIT-I**

**Introduction**

History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines, Direct and Indirect Processes; Prototyping, Manufacturing and Tooling.

**Layer Manufacturing Processes**:

Polymerization, Sintering and Melting, Extrusion, Powder Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bioplotter.

**UNIT -II**

**Development of Additive Manufacturing Technology**

Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.

**Generalized Additive Manufacturing Process Chain**;

The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

**UNIT -III**

**Additive Manufacturing Processes**

**Vat Photo polymerization**; Materials, Reaction Rates, Photo polymerization Process Modeling, Scan Patterns

**Powder Bed Fusion Processes**; Material, Powder Fusion Mechanism, Process Parameters and Modeling, powder Handling

**Extrusion Based System**; Basic principles, plotting and Path Control, Other Systems

**Material Jetting**; Materials, Material Processing Fundamentals, Material Jetting Machines

**Directed Energy Deposition Processes;** General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing-Structure-Properties Relationships

**UNIT -IV:**

**Design& Software Issues**

**Additive Manufacturing Design and Strategies**; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

**Software Issue for Additive Manufacturing**; Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL files Manipulation, Beyond the STL file, Additional Software to Assist AM

**UNIT-V**

**Material Design &Quality Aspects**

MachinesforAdditiveManufacturing,Printers,SecondaryRapidPrototypingprocesses,IntellectualProperty,Product Development,Commercialization,TrendsandFutureDirectionsinAdditiveManufacturing,BusinessOpportunities

**Applications**

Aerospace,Automotive,Manufacturing,ArchitecturalEngineering,Art,Jewellery,Toys,Medical,Biomedical,Dental, Bio-printing, Tissue& Organ Engineering and many others.

**Books and References**:


1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by-Ian Gibson, D SavidW.Rosen, Brent Stucker, Springer.
2. Understanding Additive Manufacturing, by-Andreas Gebhardt, Hanser.
3. Additive Manufacturing, by-Amit Bandyopadhyay, Susmita Bose, CRC Press.
4. RapidPrototyping: Principles and Applications, by-CheeKai Chua,KahFaiLeong,ChuSingLim.

**Semester – VII : Departmental Elective – IV**

| Subject Code | HVAC SYSTEMS | L:T:P | Credits |
|---|---|---|---|
| BTME-702 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Learn the fundamentals of HVAC systems and their components. |
| **2.** | Understand the principles of heating, ventilation, and air conditioning. |
| **3.** | Analyze the design and installation of HVAC systems. |
| **4.** | Develop skills in maintaining and troubleshooting HVAC systems. |
| **5.** | Explore the energy efficiency and sustainability of HVAC systems. |

| **Course Outcome:** Student will be able to | |
|---|---|
| **CO1** | Understand the basics concepts of HVAC and various HVAC systems. |
| **CO2** | Understand the use of refrigerants with their respective applications and its future trends. |
| **CO3** | Understand the use of different auxiliary systems used in HVAC systems. |
| **CO4** | Apply the basic laws for thermodynamic analysis of different processes involved in HVAC systems. |
| **CO5** | Apply the basic concepts to calculate the HVAC loads for different applications. |
| **CO6** | Apply the concepts of psychrometry to design HVAC systems for different applications |

**UNIT-I**

**Advanced Vapour Compression Cycles:**

Review of vapour compression cycle, Effect of super heating, subcooling, condenser pressure and evaporator pressure on COP, Transcritical cycle, Ejector refrigeration cycle. Presentation of cycle on P-hand T-s chart.

**Refrigerants:**

Classification of Refrigerants, CFC, HFC, HCFC, Azeotropic, Zeotropic, Natural refrigerant, Secondary Refrigerant, Antifreeze solution, Phase Changing Materials. Desired properties of refrigerants, Requirements for refrigerant, Classification based on safety, Refrigerant oils and applications, Properties and uses of commonly used refrigerant, Greenhouse effect, Global warming, Future Refrigerants like Hydrofluoro- Olefines

**UNIT-II**

**Review of Psychrometry:**

Psychrometric properties, Psychrometric chart and Psychrometric processes, Psychrometric process in Air conditioning equipment: By pass factor, cooling and dehumidifying coils, Apparatus dew point(ADP), Heating coils, airwasher, use of hygroscopic solutionin Air Washer, adiabatic dehumidifier, water injection, stream injection, Summer Air conditioning,Winter Air conditioning, Sensible heat factor (SHF),Grand Sensible heat factor(GSHF)

**Design Condition:**

Choice of inside design condition- cold storage, Industrial air conditioning, comfort air conditioning, Human comfort, Outsidede sign condition

**UNIT-III**

**Heat Pump:**

Introduction, package heat pump with reversible cycle, decentralized heat pump, heat pump with a double bundle condenser, industrial heat pump

**Ventilation:**
Introduction, purpose of ventilation, Natural ventilation, mechanical ventilation, tunnels ventilation, mine ventilation, Natural ventilation, and mechanical ventilation.

**Air Conditioning system:**
Introduction, Unitary system, central air-conditioning system, directs expansion system, all water system, all air system, air water system.

**UNIT-IV**

**Load Calculation:**
Solar radiation, Heat gain through glass-Calculation of solar heat gain through ordinary glass tables-shading devices- effect of shading devices. Fabric heat gain, over all heat transfer coefficient, Periodic heat transfer through walls and roofs. Empirical methods to calculate heat transfer through walls and roofs using decrement factor and time lag method. Infiltration - stack effect, wind effect, in filtration load.
Internal heat loads, System heat gains, Break-up of ventilation and effective sensible heat factor, Cooling and heating load estimation, Psychrometric calculation for cooling, selection of air-conditioning apparatus, Evaporative cooling, Building requirements and energy conservation in air-conditioning buildings.

**UNIT-V**

**Air Distribution:**
Room air distribution - types of supply air outlets, mechanism of flow through outlets, selection and location of outlets, Distribution patterns of outlets - ducts- Definition and types – materials for ducts and its specification, friction loss in ducts - grills, diffusers, registers, rectangular equivalent of circular duct. Air duct designs, duct construction, duct design procedures. Equal friction method, static regains method, velocity reduction method.

**Air Conditioning Apparatus:**
Fans and blowers, types of fans, fan characteristic, centrifugal fans, axial fans, fan arrangements, Suction Line, Discharge Line (Hot-GasLine), Liquid Line, location and arrangement of piping, vibration and noise in piping, basic elements of the control system

**Text Books :**

1. Refrigeration and Air-conditioning by C.P Arora, McGraw-Hill

**Reference Books :**

1. Refrigeration and Air-conditioning by stoecker& Jones. McGraw-Hill
2. Refrigeration and Air-conditioning,by Manohar Prasad, New Age International(P)Ltd. Pub.
3. ASHRAEH and book (HVAC Equipments)
4. Refrigeration and Air-conditioning by R.C. Arora, PHI
5. Refrigeration and Air-conditioning by Arora &Domkundwar. Dhanpat Rai
6. Air Conditioning System Design Manual, II$^{nd}$edition, ASHRAE.

**Semester – VII : Departmental Elective – IV**

| Subject Code | HYBRID VEHICLE PROPULSION | L:T:P | Credits |
|---|---|---|---|
| BTME-702 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of hybrid vehicle propulsion systems. |
| **2.** | Learn the fundamentals of electric and hybrid vehicle technology. |
| **3.** | Analyze the design and performance of hybrid vehicle systems. |
| **4.** | Explore the environmental impact of hybrid vehicle technology. |
| **5.** | Develop skills in evaluating and optimizing hybrid vehicle systems. |

| **Course Outcome:** Student will be able to | |
|---|---|
| **CO-1** | Understand the basics of the hybrid electric vehicles and it's types. |
| **CO-2** | Understand the types of drive trains used in hybrid vehicles |
| **CO-3** | Understand the propulsion units used in Hybrid Vehicles and their efficiency. |
| **CO-4** | Understand the requirements and devices of energy storage used in hybrid vehicles. |
| **CO-5** | Understand the concept of downsizing of IC engines in case of hybrid vehicles. |
| **CO-6** | Understand the principles of energy management and issues related to these strategies. |

**UNIT-I**

**Introduction to Hybrid Electric Vehicles:**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

**Conventional Vehicles:**

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

**UNIT -II**

**Hybrid Electric Drive-trains:**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

**Electric Drive-trains:**

Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

**UNIT -III**

**Electric Propulsion unit:**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DCMotordrives,ConfigurationandcontrolofInductionMotordrives,configurationandcontrolofPermanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

**UNIT -IV**

**Energy Storage:**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

**Sizing the drive system:**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

**UNIT-V**

**Energy Management Strategies:**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

**Text Books:**


1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E.Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.


**Reference Books:**


1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Chris Mi,M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011.

**Semester – VII : Departmental Elective – V**

| Subject Code | MATHEMATICAL MODELING OF MANUFACTURING PROCESSES | L:T:P | Credits |
|---|---|---|---|
| BTME-703 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of mathematical modeling and its applications. |
| **2.** | Learn the principles of manufacturing processes and their modeling. |
| **3.** | Analyze the behavior of materials during manufacturing processes. |
| **4.** | Explore the optimization and simulation of manufacturing processes. |
| **5.** | Develop skills in using mathematical models to improve manufacturing processes. |

| **Course Outcome :** Student will be able to | |
|---|---|
| **CO1** | Understand the fundamentals of manufacturing processes, mathematical models And their solutions |
| **CO2** | Understand unconventional and conventional machining, their discrete-time linear, non-linear models and solutions |
| **CO3** | Analyze the mechanism of forming and heat transfer in welding |
| **CO4** | Apply the principles of casting, powder metallurgy, coating and additive Manufacturing |
| **CO5** | Understand the fundamental of heat treatment, micro/nano manufacturing and Processing of non-metallic materials. |

**UNIT-I**

Introduction to Manufacturing processes; Materials Processing; Types and Properties of Engineered Materials; Evaluation of Properties of Manufactured Products; Statistical and data-driven modelling approach; Overview of mathematical modeling, types of mathematical models and methods to solve the same. Physics of manufacturing processes; Solid-state deformation (Elasticity and Plasticity) and residualstresses;solid-statephasetransformationandrecrystallization;meltingandsolidification;CoupledSystems

**UNIT-II**

Conventional machining; Orthogonal cutting; Tool geometry; chip formation; force components; heat generation; tool life; mathematical modelling approach; solution of problems; Introduction to discrete-time linear and non-linear models. Non-conventional machining; Principal and mechanism of different processes; Parametric analysis of heat transfer,material removal, and surface finish.

**UNIT-III**

Metal forming; Mechanics of bulk metal forming; mechanics of sheet metal forming; heat transfer and deformation; Welding; Fusion welding; Welding-heat source modeling, temperature distribution, effect of surface- active elements, modes of metal transfer in welding; Solid-state welding; Solidification and microstructure; Residual stress and distortion.

**UNIT-IV**

Casting and powder metallurgy; Cooling and Solidification; principle of powder metallurgy; Coating and additive manufacturing; Principle of surface and coating technology; Principle and development of additive manufacturing technologies

**UNIT-V**

Heat treatment; Fundamentals of heat treatment; Evaluation of microstructure properties and residualstressofdifferentmanufacturingprocesses.Micro/nanoscalemanufacturing;Down-scalingofconventional manufacturing processes, Change of properties, Micro-to-nano manufacturing; Packaging, finishing, micro joining and nano joining, micro casting, micro forming, micromachining. Processing of non-metallic materials; Principle of plastic processing and shaping of plastics, processing of non-metallic bio-materials; Principle of glass and ceramics processing and shaping of glass and ceramics.

**Books and References**


1. A Ghoshand A K Mallik: Manufacturing Science,East-WestPressPvtLtd,2ndEd.,2010.
2. DA Brandt, J C Warner: MetallurgyFundamentals,Goodheart-Willcox,2009.
3. C Lakshmana Rao and Abhijit P Deshpande: Modelling of Engineering Materials, Ane Books Pvt. Ltd., New Delhi, India,2010.
4. J.Chakrabarty:Theory of plasticity,3rdEds,ElsevierIndia,2009.
5. NormanYZhou:MicrojoiningandNanoioining,Woodheadpublishing,2008
6. RW Messler: Principles of WeldingJohnWileyandSons,1999.
7. J T Blackand Ronald A Kohser: De Garmo's Materials &processes inManufacturingWiley-India,2010.
8. VKJain:AdvancedMachiningProcesses, AlliedPublishers,Mumbai,2002.
9. YiQin:MicromanufacturingEngineeringandTechnology,Elsevier,2015.
10. JZhangand Yeon Gil Jung: Additive Manufacturing: Materials, Processes, Quantifications and Applications, Elsevier, 2018.
11. JA Dantzig and M Rappaz: Solidification,C R Spress, 2009.
12. J.N.Kapur,MathematicalModelsinBiologyandMedicine,East-WestPressPrivatelimited.
13. Leah,Edelstein,Keshet,MathematicalModelsinBiology,SIAMpublications.
14. J.D.Murray,MathematicalBiologyVol.I,II,3rdedition,Springerpublications.


**Related Course's/Useful Links**

1. https://www.digimat.in/nptel/courses/video/112103273/L01.html
2. https://swayam.gov.in/nd1_noc20_ma47/preview

**Semester – VII : Departmental Elective – V**

| Subject Code | MACHINE LEARNING | L:T:P | Credits |
|---|---|---|---|
| BTME-703 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of machine learning and its applications. |
| **2.** | Learn the fundamentals of supervised and unsupervised learning techniques. |
| **3.** | Analyze the different types of machine learning algorithms. |
| **4.** | Explore the applications of machine learning in real-world scenarios. |
| **5.** | Develop skills in implementing machine learning models for data analysis. |

| **Course Outcomes:** Students are able to | |
|---|---|
| **CO1** | Understand the need of machine learning concepts |
| **CO2** | To Understand a wide variety of ML Algorithms and how to evaluate models generated from data |
| **CO3** | Solve prediction based problems |
| **CO4** | Analyze machine learning algorithms |
| **CO5** | Apply the Algorithms to real-world problems |

**UNIT-I**

**Introduction to Machine Learning**

An Introduction to Machine Learning, Types of Machine Learning, and Applications of ML in Mechanical Engineering, Designing a Learning System, Performance Measures for ML Model, Issues in Machine Learning, AI vs.ML, and Essential Math for M L and AI, Data Science Vs Machine Learning

**UNIT-II**

**Supervised Learning**

Supervised Learning: Introduction to Supervised Learning, Classification, Regression Analysis and its Types , Model Selection Procedures, Bayesian Decision Theory, Naïve Bayes Classifier, Bayes Optimal Classifier, Evaluating an Estimator: Bias and Variance, Support Vector Machines, Types of Support Vector Kernel(Linear Kernel, Polynomial Kernel, Gaussian Kernel, Issues in SVM, Case Study on House Price Prediction using Machine Learning.

**UNIT-III**

**Unsupervised Learning**

Unsupervised Learning: Introduction to Unsupervised Learning, Cluster Analysis, K-Means Clustering, Expectation Maximization Algorithm, Dimensionality Reduction: Principal Components Analysis, Independent Component Analysis, Multi dimensional Scaling, Linear Discriminant Analysis.

**UNIT-IV**

**Decision Tree &Neural Networks**

Decision Trees: Basics of Decision Tree, Issues in Decision tree learning, ID3 Algorithm, Information gain and Entropy.

Introduction to Neural Networks: Perceptron, The Back propagation Algorithm, The Convergence analysis and universal approximation theorem for back propagation algorithm, Concept of Convolution Neural Networks, Types of Layers of CNN, Case Study of CNN (either on Self driving car, Building a smart speaker, etc.)

**UNIT-V**

**Genetic Algorithms &Reinforcement Learning Genetic Algorithm**: Introduction, Components of Genetic Algorithm, Cross Over, Mutation, Model of Evolution and Learning, Applications of Genetic Algorithm

**Reinforcement Learning**: Introduction to Reinforcement Learning, Learning task, Model-Based Learning Q-Learning, Markov Decision Process, Q Learning Function, Temporal Difference Learning, Generalization,

**Text Book:**


1. TomM.Mitchell,—MachineLearning,McGraw-HillEducation(India)PrivateLimited,2013.
2. EthemAlpaydin,—IntroductiontoMachineLearning(AdaptiveComputationandMachineLearning),TheMITPress 2004.
3. StephenMarsland,—MachineLearning:AnAlgorithmicPerspective,CRCPress,2009.
4. Bishop,C.,PatternRecognitionandMachineLearning.Berlin:Springer-Verlag.

**Semester – VII : Departmental Elective – V**

| Subject Code | COMPUTER GRAPHICS AND PRODUCT MODELING | L:T:P | Credits |
|---|---|---|---|
| BTME-703 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of computer graphics and its applications. |
| **2.** | Learn the principles of product modeling and design. |
| **3.** | Analyze the different types of computer graphics software. |
| **4.** | Explore the techniques used in 3D modeling and visualization. |
| **5.** | Develop skills in creating and manipulating digital models for product design. |

| **Course Outcome:** Student will be able to | |
|---|---|
| **CO1** | Understand the components of a computer graphics with object representation and to develop algorithm for graphics system components. |
| **CO2** | Understand the basic principles of 3-dimensional computer graphics and express the 3D model with illumination and shading effects. |
| **CO3** | Develop a 3D solid model using 3D Solid Modeling Software |
| **CO4** | Identify the customer needs in order to develop a business model for new product. |
| **CO5** | Develop strategy for designing and development of a new product |

**UNIT-I**

Introduction to computer graphics–historical evolution, issues and challenges, graphics pipeline, hardware and software basics; line and circle drawing algorithms, , Object representation – boundary representation, splines-cubic, Bezier, B-spline and NURBS, space partitioning

**UNIT-II**

Modeling transformations – matrix representation, homogeneous coordinate system, composition, 3D transformations; Illumination and shading–background, simple lighting model, shading models, intensity representation, color models, texture synthesis.

**UNIT-III**

3D Graphics: Polygon surfaces-Polygon mesh representations, Quadric and Super quadric surfaces and blobby objects; Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Colormodels. Application Commands for 3D Solid Modeling Software like Solid works/Autodesk Inventor/PTC Creo/ Catia(Anyone)etc.

**UNIT-IV**

Managing Product Development- Introduction; Business Models for New Products; Managing Product Development; Understanding Customer Needs-Identifying New Product Opportunities, Market Research for New Product Development. Introduction to Product Life Cycle Management and related software

**UNIT-V**

OrganizingProductDevelopment-ProductArchitecture,DesignformanufacturingandPrototyping;Organizing for Product Development; Developing Services and Product Service Systems; New Product Strategy-Building Markets and Creating Demand for New Products; Intellectual Property Issues in Product Development; New Product Business Plans– Strategy Consulting for New Products; Design Thinking for New Products -Designing Products for Emerging Markets; Design Thinking for New Products

**Books and References**


1. Samit Bhattacharya.(2015).Computer Graphics. Oxford University Press.
2. Hearn,D.& Baker,M.P.(2003).Computer Graphics with OpenGL,(3rd ed),Pearson.
3. Drew Boyd &Jacob Goldenberg(2013) Insidethe Box:The Creative Method that Works for Everyone
4. Joseph V. Sinfield, Edward Calder, Bernard McConnell, and Steve Colson (2012) How to IdentifyNewBusinessModels,MITSloanManagementReviewVol.53,No.2.
5. Chun-CheHuang(2000) Overview of Modular Product Development, Proc.National Science Council ROC(A) Vol. 24,No.3,pp.149-165
6. Marc H. Meyer and Arthur DeTore (1999) Product Development for Services, The Academy of Management Executive, Vol. 13, No. 3, Themes: Teams and New Product Development (Aug.,1999),pp.64-76


**Related Course's/Useful Link**

1. https://swayam.gov.in/nd1_noc20_cs90/preview
2. .https://nptel.ac.in/courses/106/106/106106090/
3. https://nptel.ac.in/courses/112/102/112102101/
4. https://swayam.gov.in/nd1_noc20_me12/preview
5. https://swayam.gov.in/nd1_noc20_de05/preview

**Semester – VII : Departmental Elective – V**

| Subject Code | POWER PLANT ENGINEERING | L:T:P | Credits |
|---|---|---|---|
| BTME-703 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Learn the fundamentals of power plant engineering and operation. |
| **2.** | Understand the types of power generation technologies and their applications. |
| **3.** | Analyze the thermodynamics of power generation cycles. |
| **4.** | Explore the environmental impact of power generation. |
| **5.** | Develop skills in designing and optimizing power plant systems. |

| **Course Outcome:** The student will be able to | |
|---|---|
| **CO-1** | Understand the different sources of power generation and their impact on environment. |
| **CO-2** | Understand the elements of power generation using conventional and non- Conventional energy sources. |
| **CO-3** | Understand the concepts of electrical systems used in power plants. |
| **CO-4** | Apply the basic concepts of thermodynamics to measure the performance of Different power plants. |
| **CO-5** | Determine the performance of power plants based on load variations. |

**UNIT-I**

**Introduction to Power Plants**

Introduction to the sources of energy: conventional and non conventional; Principal types of power plants; Present status and future trends; Carbon credits.

**Thermal Power Plant**

General layout of modern thermal power plant, Review of Rankine and modified Rankine cycles, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.

**UNIT-II**

**Hydroelectric Power Plant**

Hydro-electric plant, General arrangement of hydroelectric power plant, Plant layout, Penstock and water hammer, Specific speed and capacity calculations, Classification of hydro-plant, Low-,medium-and high-head plants, Pumped storage plant, Run-off river power plant, Surge tanks.

**Gas turbine power plant:**

Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, combined cycle power plants, Sites election of gas turbine power plant, Integrated Gas fire based Combined Cycle (IGCC) systems. Controlling of air fuel ratio (AFR)in power plant.

**UNIT-III**

**Nuclear Power Plants**

Classification of nuclear reactors, Thermal fission reactors and power plant and their location, Pressurized water reactor, Boiling water reactor, CANDU heavy water reactor, Gas-cooled reactor, Fast breeder reactors, Organic substance cooled reactor, Reactor control, Radiation hazards, Radioactive waste disposal, Nuclear power generation in India**.**

**Solar Power Plant**

Solar energy collectors, Photovoltaic power system, Solar central receiver system, Solar thermal energy, types of solar thermal plant, typical layout and components, solar parabolic trough plants, solar tower power plants, and solar dish power plants. Working principle of concentrating solar thermal power plant and their applications.

**Unit-IV**

**Non-Conventional Power Plants**

**Geothermal energy:** Hydrothermal systems, Petro thermal systems, Hybrid geothermal fossil systems, Problems associated with geothermal conversion,

**Wind energy:** Components of a wind generator, Horizontal and vertical axis wind mills, Aerodynamic considerations of wind mill design, Coefficient of performance of wind mill rotor, Availability of wind energy in India, Wind power by country.

**Tidal energy:** The simple single pool tidal system, The modulated single pool tidal system, The two-pool tidal system, Ocean thermal energy conversion, Principle of working, Ocean temperature differences, The open or Claude cycle, The closed or Anderson OTEC cycle, Electricity generation from Fuel cells and city garbage.

**Unit-V**

**Electrical system**:

Introduction to generator and exciters, Earthing of power systems, Power and unit transformer, Circuit breakers, Protective equipment, Switch gear.

**Power Plant Economics:**

Types of loads, Effect of variable load on power plant design and operation, Methods to meet variableload,Predictionoffutureloads,Terminologyusedinpowersupply,Cost of electrical energy, Depreciation, Energy rates (tariffs) for electrical energy, Factors affecting economics of generation and distribution of power

**Environmental Aspects of Power Station**

Environmental aspects, Different pollutants due to thermal power plant and their effect on humanhealth,Thermalpollutionofwateranditscontrol,Effluentsfrompowerplantsandimpactonenvironment,Radiationfromnuclearpowerplanteffluents,Methodsofpollutionmitigationandcontrol.

**Books and References:**


1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India.
3. Power Plant Technology, by Wakil, Mc Graw Hill.
4. Power Plant Engineering by P.K. Nag, Tata Mc Graw Hill.
5. Steam& Gas Turbines& Power Plant Engineering by R. Yadav, Central Pub.House.

**Semester – VII : Departmental Elective – V**

| Subject Code | VEHICLE BODY ENGINEERING & SAFETY | L:T:P | Credits |
|---|---|---|---|
| BTME-703 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of vehicle body engineering and design. |
| **2.** | Learn the principles of vehicle safety and crashworthiness. |
| **3.** | Analyze the different types of vehicle bodies and their components. |
| **4.** | Explore the materials used in vehicle body engineering. |
| **5.** | Develop skills in designing and testing vehicle bodies for safety. |

| **Course Outcome:** The student will be able to | |
|---|---|
| **CO-1** | Understand the classification of the vehicles on the basis of body. |
| **CO-2** | Understandtheimportanceofmaterialselectionindesigningautomotivebodies. |
| **CO-3** | Understand the concepts of aerodynamics used in designing automobiles. |
| **CO-4** | Understand the importance of interior and exterior ergonomics while designing the vehicle. |
| **CO-5** | Identify various sources of noise and methods of noise separation and various safety aspects in a given vehicle. |
| **CO-6** | Calculate various aerodynamic forces and moments acting on vehicle, load distribution in vehicle body and stability of vehicle. |

**UNIT-I**

**Classification of Coach work:**

Styling forms, coach and bus body style, layout of cars, buses and coach with different seating and loading capacity, types of commercial vehicles, vans and pickups, etc. Terms used in body building construction, angle of approach, Angle of departure, ground clearance, Cross bearers, floor longitudes, posts, seat rail, waist rail, cant rail, Roof stick, Roof longitude, Rub rail, skirt rail, truss panel, wheel archstructure, wheel arch, post diagonals, gussets.

**UNIT-II**

**Vehicle Body Materials:**

Aluminum alloys, Steel, alloy steels, plastics, Metal matrix composites, structural timbers - properties, glass reinforced plastics and high strength composites, thermoplastics, ABS and styrenes, load bearing plastics, semi rigid PUR foams and sandwich panel construction. Paints adhesives and their properties, corrosion and their prevention.

**UNIT-III**

**Aerodynamics:**

Basics, Vehicle drag and types, Various types of forces and moments, effects of forces and moments, various body optimization techniques for minimum drag, Principle of wind tunnel technology, flow visualization techniques, tests with scale models, aerodynamic study for heavy vehicles.

**Load Distribution:**

Type of body structures, Vehicle body stress analysis, vehicle weight distribution, Calculation of loading for static loading, symmetrical, longitudinal loads, side loads, stress analysis of bus body structure under bending and torsion.

**UNIT-IV**

**Interior Ergonomics:**

Introduction,Seatingdimensions,Interiorergonomics,ergonomicssystemdesign,seatcomfort,suspensionseats,splitframeseating,backpassionreducers,dashboardinstruments,electronicdisplays,commercialvehiclecabinergonomics,mechanicalpackagelayout,goodsvehiclelayout.Visibility,regulations,driversvisibility,methodsofimprovingvisibility,Windowwindingandseatadjustment mechanisms.

**Vehicle Stability:**

Introduction, Longitudinal, lateral stability, vehicle on a curvilinear path, critical speed for toppling and skidding. Effect of operating factors on lateral stability, steering geometry and stabilization of steerable wheels, mass distribution and engine location on stability.

**UNIT-V:**

**Noise and Vibration:**

Noise characteristics, Sources of noise, noise level measurement techniques, Body structural vibrations, chassis bearing vibration, designing against fatigue, methods of noise suppression.

**Impact protection:**

Basics, physics of impact between deformable bodies, design for crash worthiness, occupant and cargorestraint, passive restraint systems, side impact analysis, bumper system, energy absorbent foams, laws of mechanisms applied to safety**.**

**Books& Reference:**


1. Bosch,"AutomotiveHandbook",8thEdition,SAEpublication,2011.
2. PowloskiJ.,"VehicleBodyEngineering",Businessbookslimited,London,1969.
3. RonaldK.Jurgen,"AutomotiveElectronicsHandbook",SecondEdition,McGraw-HillInc.,1999.
4. VehiclebodyengineeringGilesJPawlowskyBusinessbookslimited1989
5. VehiclebodylayoutandanalysisJohnFentonMechanicalEngg.Publicationltd,London.1990
6. VehicleSafety2002CornwellpressTownbridge,UKISBN 1356–1448
7. Aerodynamics of Road Vehicles W.H.HuchoButterworth's19874thEdition

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | FILTER DESIGN | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand about the characteristics of different filters. |
| **2.** | Understand the concept of Approximation Theory. |
| **3.** | Learn about the switched capacitor filter. |
| **4.** | Learn the principles of analog and digital filter design. |
| **5.** | Develop skills in implementing and testing filter designs. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Choose an appropriate transform for the given signal. |
| **CO2** | Choose appropriate decimation and interpolation factors for high performance filters. |
| **CO3** | Model and design an AR system. |
| **CO4** | Implement filter algorithms on a given D S P processor platform. |

**UNIT–I**

**Introduction:** Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling.

**Operational amplifiers:** Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Non inverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.

**UNIT-II**

**First order filter:** Bilinear transfer functions and frequency response– Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.

**UNIT-III**

**Second order low pass and band pass filters:** Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.

**UNIT-IV**

**Second order filters with arbitrary transmission zeros:** By using summing, By voltage feed forward, cascade design revisited.

**Low pass filters with maximally flat magnitude:** the ideal low pass filter, Butter worth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.

**UNIT-V**

**Low pass filter with equal ripple (Chebyshev) magnitude eresponse:** The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design

**Inverseche by shev and cauer filters:** Inverseche by shev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.

**Books and References:**


1. Rolf.Schaumann, HaiqiaoXiao, Mac.E.VanValkenburg,“AnalogFilterDesign”,2ndIndianEdition, Oxford University Press.
2. J.MichaelJacob,“ApplicationsandDesignwithAnalogIntegratedCircuits”,Secondedition,Pearson.
3. T.Deliyannis, YichuangSun, J.K.Fidler,“Continuous-TimeActiveFilterDesign”,CRCPress.

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | BIO ECONOMICS | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of bioeconomics and its interdisciplinary nature. |
| **2.** | Learn the principles of sustainable resource management and conservation. |
| **3.** | Analyze the economic impact of biotechnology and biodiversity. |
| **4.** | Explore the relationship between agriculture, environment, and the economy. |
| **5.** | Develop skills in analyzing and solving bioeconomic problems. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | understand basic concept of Bio economics, challenges, opportunities & regulations |
| **CO2** | understand development and innovation in terms of bio economy towards sustainable development |
| **CO3** | understand Inter-and trans disciplinarily in bio economy & research approaches |
| **CO4** | Explain biobased resources, value chain, innovative use of biomass and biological knowledge to provide food, feed, industrial products |

**UNIT–I**

Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling.

Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Non inverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.

**UNIT-II**

Economic Growth, Development, and Innovation in terms of bioeconomy, Environmental Economics and the Role of Government, Modelling and Tools Supporting the Transition to a Bio economy, Role of bio based Economy in sustainable development.

**UNIT-III**

Inter-and transdisciplinarity in Bioeconomy &research approaches, primary production, processing of bio based resources, Markets, Sustainability Management and Entrepreneurship in bio based products.

**UNIT-IV**

Bio based Resources and Value Chains, Processing of Bio based Resources, Markets, Sustainability Management and Entrepreneurship opportunity in bio based product. Food Security and Healthy Nutrition in the Context of the Bio economy, Use of Biomass for the Production of Fuel and Chemicals, The importance of Bio technology for the Bio economy.

**UNIT-V**

sustainable and innovative use of biomass and biological knowledge to provide food, feed, industrial products, bio energy and ecological services, importance of bio economy-related concepts in public, scientific, and political discourse, Dynamic Management of Fossil Fuel, Bio fuel.

**Books and References:**


1. Principles of Bio economics by I. Sundar, Vedamse Books(P)Ltd New Delhi, India
2. Bio economy: Shaping the Transition to a Sustainable, Bio based Economy by Iris Lewandowski, Springer.
3. Sociobiology and Bio economics by Koslowski, Peter
4. Modeling, Dynamics, Optimization and Bio economics I, by Pinto, Alberto Adrego, Zilberman, David, Springer.

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | MACHINE LEARNING | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the basics of machine learning and design a learning system. |
| **2.** | Learn the concept learning task and the decision tree learning algorithm. |
| **3.** | Gain knowledge about artificial neural networks, evaluating hypotheses, and Bayesian learning. |
| **4.** | Explore computational learning theory, instance-based learning, and genetic algorithms. |
| **5.** | Learn about learning first-order rules, reinforcement learning, and their applications. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Understand the basics of machine learning and design a learning system. |
| **CO2** | Learn the concept learning task and the decision tree learning algorithm. |
| **CO3** | Gain knowledge about artificial neural networks, evaluating hypotheses, and Bayesian learning. |
| **CO4** | Explore computational learning theory, instance-based learning, and genetic algorithms. |
| **CO5** | Learn about learning first-order rules, reinforcement learning, and their applications.<br>Course Outcom |

**UNIT–I**

INTRODUCTION– Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNINGTASK- General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias.

**UNIT-II**

DECISION TREE LEARNING-Decision tree learning algorithm-Inductive bias-Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS– Perceptrons ,Gradient descent and the Delta rule, Adaline, Multi layer networks, Derivation of back propagation rule Back propagation Algorithm Convergence, Generalization.

**UNIT-III**

Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief net works, EM algorithm.

**UNIT-IV**

Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASEDLEARNING–k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function net works, Case-based learning.

**UNIT-V**

Genetic Algorithms: an illustrative example, Hypothesis spacesearch, Genetic Programming, Models of Evolution and Learning; Learning first order rules- sequential covering algorithms-General to specific beam search-FOIL;REINFORCEMENTLEARNING-The Learning Task, Q learning.

**Books and References:**


1. TomM. Mitchell,―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin,―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C. ,Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | RENEWABLE ENERGY RESOURCES | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1** | Understand non-conventional energy resources and their classification. |
| **2** | Learn the theory, materials, and limitations of solar cells and thermal energy. |
| **3** | Explore geothermal energy, MHD, fuel cells, wind energy, and bio-mass. |
| **4** | Study thermo-electrical and thermionic conversions, OTEC, and waste recycling. |
| **5** | Analyze the performance and limitations of renewable energy conversion systems. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | classify and analyze non-conventional energy resources. |
| **CO2** | Knowledge of solar cells, thermal energy, and limitations. |
| **CO3** | Understanding of geothermal energy, MHD, fuel cells, and wind energy. |
| **CO4** | Familiarity with thermo-electrical and thermionic conversions, OTEC, and waste recycling. |
| **CO5** | Capacity to analyze the performance and limitations of renewable energy systems. |

**UNIT–I**

Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells .Solar cell materials, solar cell array, solar cell power plant, limitations.

**UNIT-II**

Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power Plants, thermal energy storage for solar heating and cooling, limitations.

**UNIT-III**

Geothermal Energy: Resources of geothermal energy, thermodynamics of geo- thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working,
Performance and limitations.

**UNIT-IV**

Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.

**UNIT-V**

Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.

**Books and References:**


**1.** Raja etal,"Introduction to Non-Conventional Energy Resources" Scitech Publications.

**2.** JohnTwideuandTonyWeir,"RenewalEnergyResources"BSPPublications,2006.

**3.** M.V.R. Koteswara Rao, "Energy Resources: Conventional &Non-Conventional" BSPPublications,2006.

**4.** D.S.Chauhan,"Non-conventionalEnergyResources"NewAgeInternational.

**5.** C.S.Solanki,"RenewalEnergyTechnologies:APracticalGuideforBeginners"PHILearning.

**6.** Peter Auer ,"Advances in Energy System and Technology". Vol.1&IIEditedbyAcademic Press.

**7.** Godfrey Boyle," Renewable Energy Power for a Sustainable Future", Oxford University Press.

## Semester – VII : OPEN ELECTIVES II

| Subject Code | OPERATIONS RESEARCH | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the definition, scope and phases of operations research. |
| **2.** | Learn about linear programming, transportation and assignment problems, and network techniques. |
| **3.** | Study project management and the theory of games. |
| **4.** | Understand queuing models, quality systems, inventory control, and replacement models. |
| **5.** | Develop skills to solve complex problems using OR models. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | apply operations research techniques to solve real-world problems. |
| **CO2** | Understanding of linear programming, transportation, and assignment problems, and their applications. |
| **CO3** | Knowledge of project management and network techniques. |
| **CO4** | Familiarity with queuing models, quality systems, inventory control, and replacement models. |
| **CO5** | Improved problem-solving skills and ability to model and analyze complex systems. |

**UNIT–I**

Introduction: Definition and scope of operations research (OR),OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of LinearProgramming, duality, sensitivity analysis.

**UNIT-II**

Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.

**UNIT-III**

Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem.

Project Management: Phases of project management, guidelines for network construction, CPM and PERT

**UNIT-IV**

Theory of Games: Rectangular games, Minimax theorem, graphical solution of 2xnormx2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized poisson queing model, single server models.

**UNIT-V**

Inventory Control: Models of inventory, operation of inventory system, Quantity discount. Replacement: Replacement models: Equipments that Deteriorate with time, equipments that fail with time.

**Books and References:**


1. WayneL.Winston,"OperationsResearch"ThomsonLearning,2003.
2. HamdyH.Taha,"OperationsResearch-AnIntroduction"PearsonEducation,2003.
3. R.PanneerSeevam,"OperationsResearch"PHILearning,2008.
4. V.K.Khanna,"TotalQualityManagement"NewAgeInternational,2008

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | VISION FOR HUMANE SOCIETY | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | To help the students to understand the importance and types of relationship with expressions. |
| **2.** | To develop the competence to think about the conceptual frame work of undivided society as well as universal human order. |
| **3.** | To help the students to develop the exposure for transition from current state to the undivided society and universal human order. |
| **4.** | Analyze the challenges faced by society and individuals. |
| **5.** | Explore the role of vision and leadership in creating a humane society. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | systematic and rational study of the human being vis-à-vis the rest of existence. |
| **CO2** | do's and do n'ts related to values. |
| **CO3** | a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated and encouraged to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation. |
| **CO4** | process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue with in the student leading to continuous self-evolution. |
| **CO5** | self-exploration also enables them to critically evaluate their pre- conditionings and present beliefs. |

**UNIT–I**

Introduction to the course: Basic aspiration of a Human Being and program for its fulfilment, Need for family and relationship for a Human Being, Human-relationship and role of work in its fulfillment ,Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of The Current State, Appraisal of Efforts in this Direction in Human History.

**UNIT-II**

Understanding Human- Human Relationship & its fulfilment: Recognition of Human-Human Relationship, Recognitionoffeelingsinrelationship,EstablishedValuesand Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings, Types of relationship and their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.

**UNIT-III**

Justice from family to world family order: Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity ofcultureandcivilization,UniversalOrderonthebasis of Undivided Society,Conceptual Framework for Universal human order, Universal Human Order ascontinuityandexpanseoforderinliving:fromfamilyordertoworldfamily order, a conceptual frame work for universal human order.

**UNIT-IV**

ProgramforEnsuringUndividedSocietyand Universal Human Order: Education– Sanskar,Health Sanyam, Production-work, Exchange–storage, Justice-preservation.

**UNIT-V**

Human Tradition: Scope and Steps of Universal Human Order, Human Tradition ( Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present Efforts in this direction, Sumup.

**Books and References:**


1. AFoundationCourseinHumanValuesandProfessionEthics(TextBookandTeachers'Manual), R .R. Gaur, R.Asthana, G.P. Bagaria (2010), Excel Books, New Delhi.
2. AvartansheelArthshastra, A.Nagraj, DivyaPathSansthan, Amarkantak, India.
3. AnAppealbytheDalaiLamatotheWorld: EthicsAreMoreImportantThanReligion, DalaiLamaXIV, 2015.
4. EconomyofPermanence–(aquestforsocialorderbasedonnon-violence),J.C. Kumarappa(2010),Sarva-Seva-Sangh-Prakashan,Varansi,India.
5. EnergyandEquity, IvanIllich (1974), TheTrinityPress, Worcester&HarperCollins, USA.
6. HumanSociety, KingsleyDavis,1949.
7. HindSwarajor, IndianhomeruleMohandasK.Gandhi, 1909.
8. IntegralHumanism, DeendayalUpadhyaya, 1965.
9. LohiyaKeVichar, LokBharti, RammanoharLohiya, 2008.
10. ManavVyavaharDarshan, A.Nagraj, DivyaPathSansthan, Amarkantak, India.
11. ManaviyaSanvidhan,A.Nagraj,DivyaPathSansthan,Amarkantak,India
12. SamadhanatmakBhautikvad,A.Nagraj,DivyaPathSansthan,Amarkantak,India
13. SmallIsBeautiful: AStudyofEconomicsasifPeopleMattered, E.F.Schumacher, 1973, Blond&Briggs, UK.
14. SlowisBeautiful,CecileAndrews(http://www.newsociety.com/Books/S/Slow-is-Beautiful)
15. SociologyThemesandPerspectives, HarperCollins; EIGHT edition (2014), Martin Hol bornand Peter Langley, 1980.
16. Samagrakranti: JayaPrakashNarayan'sphilosophyofsocialchange, Siddharth Publications Renu Sinha, 1996.
17. Science & Humanism– towardsa unifiedworldview,P.L.Dhar&R.R.Gaur (1990), Common wealth Publishers ,NewDelhi
18. VyavaharvadiSamajshastra,A.Nagraj,DivyaPathSansthan,Amarkantak,India.
19. VyavahatmakJanvad,A.Nagraj,DivyaPathSansthan,Amarkantak,India.
20. TheCommunistManifesto,KarlMarx,1848.
21. TowardaTrueKinshipofFaiths:HowtheWorld'sReligionsCanComeTogetherDalaiLamaXIV, 2011


**Reference Videos:**

1. Kin school(30minutes)
2. Technology (Solar City etc.).
3. Natural Farming.
4. Economics of Happiness (1h8m).

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | DESIGN THINKING | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of design thinking and its principles. |
| **2.** | Learn the process of human-centered design and empathy building. |
| **3.** | Analyze the different stages of the design thinking process. |
| **4.** | Explore the applications of design thinking in solving complex problems. |
| **5.** | Develop skills in applying design thinking to real-world design challenges. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Develop a strong understanding of the design process and apply it in a variety of business settings |
| **CO2** | Analyze self, culture, teamwork to work in a multidisciplinary environment and exhibit empathetic behavior |
| **CO3** | Formulate specific problem statements of real time issues and generate innovative ideas using design tools |
| **CO4** | Apply critical thinking skills in order to arrive at the root cause from a set of likely causes |
| **CO5** | Demonstrate an enhanced ability to apply design thinking skills for evaluation of claims and arguments. |

**UNIT–I**

Introduction to design thinking, traditional problem solving versus design thinking, history of design thinking, wicked problems. Innovation and creativity, the role of innovation and creativity in organizations, creativity in teams and their environments, design mindset. Introduction to elements and principles of design, 13Musical Notes for Design Mind set, Examples of Great Design, Design Approaches across the world.

**UNIT-II**

Understanding humans as a combination of I (self) and body, basic physical needs upto actualization, prosperity, the gap between desires and actualization. Understanding culture in family society, institution, startup, socialization process. Ethical behavior: effects on self, society, understanding core values and feelings, negative sentiments and how to over come them, definite human conduct: universal human goal, developing human consciousness in values, policy, and character. Understand stakeholders, techniques to empathize, identify key user problems. Empathy tools-Interviews, empathy maps, emotional mapping, immersion and observations, customer journey maps, and brain storming, Classifying insight safter Observations, Classifying Stakeholders, Do's& Don'ts for Brain storming, Individual activity-'Moccas in walk'

**UNIT-III**

Defining the problem statement, creating personas, Point of View (POV) statements. Research-identifying drivers, information gathering, target groups, samples, and feedbacks. Idea Generation-basic design directions, Themes of Thinking, inspirations and references, brain storming, inclusion, sketching and presenting ideas, idea evaluation, double diamond approach, analyze – four W's, 5 why's, "How Might We", Defining the problem using Ice-Cream Sticks, Metaphor & Random Association Technique, Mind-Map, ideation activity games - six thinking hats, million-dollar idea, introduction to visual collaboration and brain storming tools-Mural, Jam Board

**UNIT-IV**

Fundamental concepts of critical thinking, the difference between critical and ordinary thinking, characteristics of critical thinkers, critical thinking skills-linking ideas, structuring arguments, recognizing incongruence, five pillars of critical thinking, argumentation versus rhetoric, cognitive bias, tribalism, and politics. Case study on applying critical thinking on different scenarios.

**UNIT-V**

The argument, claim, and statement, identifying premises and conclusion, truth and logic conditions, valid/invalid arguments, strong/weak arguments, deductive argument, argument diagrams, logical reasoning, scientific reasoning, logical fallacies, propositional logic, probability, and judgment, obstacles to critical thinking. Group activity/role plays on evaluating arguments.

**Books and References:**


1. VijayKumar,101DesignMethods:AStructuredApproachforDrivingInnovationinYourOrganization,2013,JohnWileyandSonsInc,NewJersey
2. BPBanerjee,FoundationsofEthicsandManagement,2005,ExcelBooks
3. GavinAmbroseandPaulHarris,BasicsDesign08:DesignThinking,2010,AVAPublishingSA
4. RogerL.Martin,DesignofBusiness:WhyDesignThinkingistheNextCompetitiveAdvantage,2009, HarvardBusinessPress,BostonMA

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | SOIL AND WATER CONSERVATION ENGINEERING | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | understand the concept and scope of soil conservation engineering. |
| **2.** | learn about the various types and causes of soil erosion. |
| **3.** | study the methods of soil erosion control, including biological methods. |
| **4.** | gain knowledge about water conservation techniques and the economics of water resource utilization. |
| **5.** | understand the importance of floodplain management and methods of reducing the impact of flooding. |

| **Course Outcome (CO):** The Students will be able to | |
|---|---|
| **CO1** | understand the importance and scope of soil conservation engineering. |
| **CO2** | identify and analyze the various types and causes of soil erosion and their impact. |
| **CO3** | gain knowledge about different methods of soil erosion control, including biological methods, and their effectiveness. |
| **CO4** | apply the principles of water conservation and understand the economics of water resource utilization. |
| **CO5** | understand the importance of floodplain management and be able to suggest methods for reducing the impact of flooding. |

**UNIT–I**

Definition and scope of soil conservation, cause of soil erosion, Mechanism of erosion, universal soil loss equation, soil erosion due to wind and its control, vegetation management, i.e., strip cropping, stubble mulching and other practices.

**UNIT-II**

Types of soil erosion due to water- sheet erosion, rill erosion, gully erosion, sediment transport in channels, sediment deposition in reservoirs. Methods of soil erosion control: bounding and terracing on agriculture land for gully control, bench terraces, vegetated water ways, chute spillways, drop inlet spillways, check dams, river training works.

**UNIT-III**

Biological methods of soil erosion control, grass land management, forest management. Soil quality management, drainage works, reclamation of salt affected soils. Water conservation: water harvesting, rainfall- run off relation, water storage in ponds, lakes, reservoirs and aquifers ,ground water recharge Through wells, check dams and storage works.

**UNIT-IV**

Water losses: filtration, seepage and evaporation losses, pollution/contamination of water quality due to agricultural practices i.e., fertilizers and pesticides, self purification of surface water, sources of agricultural water pollution, pollutant dispersion in ground water.

**UNIT-V**

Need of planned utilization of water resources, economics of water resources utilization. Flood plain zones management, modifying the flood, reducing susceptibility to damage, reducing the impact of flooding.

**Books and References:**


1. Alam Singh – Modern Geotechnical Engineering
2. K. R. Arora – Soil Mechanics and foundation Engineering.
3. N. C. Brady – Principles of Soil Sciences
4. B. C. Punmia – Soil Mechanics and Foundation Engineering

**Semester – VII : OPEN ELECTIVES II**

| Subject Code | INTRODUCTION TO WOMEN'S AND GENDER STUDIES | L:T:P | Credits |
|---|---|---|---|
| BTME-704 | | 3:0:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the concepts of sex and gender. |
| **2.** | Analyze the influence of gender in shaping institutions. |
| **3.** | Evaluate theories of gender construction and patriarchy. |
| **4.** | Examine feminist theories and movements. |
| **5.** | Evaluate the psychology of gender roles and representations. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Identify and explain the differences between sex and gender. |
| **CO2** | Analyze the influence of gender in shaping institutions and societies. |
| **CO3** | Evaluate the impact of gender constructions and patriarchy on individuals and societies. |
| **CO4** | Examine feminist theories and movements and their historical and contemporary significance. |
| **CO5** | Evaluate the psychology of gender roles and representations and their impact on mental health, relationships, and social norms. |

**UNIT–I**

Women and Society: Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Private and Public dichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.

**UNIT-II**

Feminist Theory: Rise of Feminism, Introduction to various stands of Feminism-Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post Colonial Feminism, Post Modern Feminism. Waves of Feminism.

**UNIT-III**

Women's Movement: The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920,Historical Developments of Social Reform Movements in India ,Women's groups and organizations, Women's Movement Movements for Uniform Civil code and ShahBano case, Dalit women and the question of double marginality.

**UNIT-IV**

Gender Roles and Psychology of Sex: Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape , Taboo , Childhood Sexual Abuse , Domestic Violence , Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.

**UNIT-V**

Gender and Representation: Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.

**Books and References:**


1. Basab iChakrabarti, Women's Studies: Various Aspects. UrbiPrakashani2014
2. Arvind Narrain. Queer: Despised Sexuality Law and Social Change. Book for Change. 2005
3. Chandra Talpade Mohanty, Feminism without Borders: Decolonizing Theory, Practicing Solidarity. Duke University Press.
4. Flavia Agnes. Law and Gender Inequality: The Politics of Women's Rights in India. Oxford University Press, 2001
5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press, Sage, New Delhi, 1998.

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | FUNDAMENTALS OF DRONE TECHNOLOGY (UNMANNED AERIAL VEHICLES) | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | To make the students to understand the basic concepts of UAV drone systems. |
| **2.** | To introduce the stability and control of an aircraft. |
| **3.** | Analyze the different types of UAVs and their components. |
| **4.** | Explore the applications of UAVs in various industries. |
| **5.** | Develop skills in designing, building, and operating UAVs. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Ability to design UAV drone system |
| **CO2** | To understand working of different types of engines and its area of applications. |
| **CO3** | To understand static and dynamic stability dynamic instability and control concepts |
| **CO4** | To know the loads taken by aircraft and type of construction and also construction materials in them. |

**UNIT–I**

Introduction to Drones: Introduction to Unmanned Aircraft Systems, History of UAV drones, classification of drones, System Composition, applications.

**UNIT-II**

Design of UAV Drone Systems: Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects-India Specific, Design for Stealth.

**UNIT-III**

Avionics Hardware of Drones: Autopilot, AGL-pressure sensors- servos-accelerometer –gyros-actuators- power supply-processor, integration, installation, configuration.

**UNIT-IV**

Communication, Payloads and Controls: Payloads, Telemetry, Tracking, controls-PID feedback, radio control frequency range, modems, memory system, simulation, ground test-analysis-trouble shooting.

**UNIT-V**

Navigation and Testing: Waypoints navigation, ground control software, System Ground Testing, System In-flight Testing, Future Prospects and Challenges.

**Books and References:**


1. Reg Austin "Unmanned Aircraft Systems UAV design, development and deployment", Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, Inc, 1998.
3. Kimon P. Valavanis, "Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy", Springer, 2007
4. Paul G Fahlstrom, Thomas J Gleason, "Introduction to UAV Systems", UAV Systems, Inc, 1998
5. Dr. Armand J. Chaput, "Design of Unmanned Air Vehicle Systems", Lockheed Martin Aeronautics.

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | CLOUD COMPUTING | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of cloud computing concepts and architecture. |
| **2.** | Learn the different cloud service models and deployment models. |
| **3.** | Analyze cloud computing security and privacy concerns. |
| **4.** | Explore cloud computing scalability and virtualization techniques. |
| **5.** | Develop skills in implementing cloud-based solutions. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | describe the fundamental concepts and architectures of cloud computing. |
| **CO2** | identify and evaluate cloud service models and deployment models. |
| **CO3** | analyze cloud computing security and privacy concerns. |
| **CO4** | design and implement cloud-based solutions. |
| **CO5** | apply cloud computing scalability and virtualization techniques. |

**UNIT–I**

**Introduction:** Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed, History of Cloud Computing - Cloud Architecture - Types of Clouds -Business models around Clouds – Major Players in Cloud Computing-issues in Clouds - Eucalyptus - Nimbus - Open Nebula, CloudSim.

**UNIT-II**

**Cloud Services:** Types of Cloud services: Software as a Service-Platform as a Service –Infrastructure as a Service - Database as a Service - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.

**UNIT-III**

**Collaborating Using Cloud Services:** Email Communication over the Cloud - CRM Management – Project Management-Event Management -Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.

**UNIT-IV**

**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System VM, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - supervisors – Xen, KVM, VMware, Virtual Box, Hyper-V.

**UNIT-V**

**Security, Standards and Applications:** Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud.

Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine

**Books and References:**


1. David E.Y. Sarna, “Implementing and Developing Cloud Application”, CRC press 2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, McGrawHill 2010.
4. Haley Beard, “Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs”, Emereo Pty Limited, July 2008.

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | BIOMEDICAL SIGNAL PROCESSING | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Develop an understanding of biomedical signals and their characteristics. |
| **2.** | Learn the different methods of signal processing and analysis. |
| **3.** | Analyze the different biomedical signal processing techniques. |
| **4.** | Explore the applications of biomedical signal processing in healthcare. |
| **5.** | Develop skills in designing and implementing biomedical signal processing algorithms. |

| **Course Outcome (CO):** The Students will be able to | |
|---|---|
| **CO1** | understand the characteristics of biomedical signals. |
| **CO2** | apply signal processing techniques to biomedical data. |
| **CO3** | analyze and evaluate different biomedical signal processing techniques. |
| **CO4** | design and implement biomedical signal processing algorithms. |
| **CO5** | apply biomedical signal processing techniques to healthcare applications. |

**UNIT–I**

Introduction to Bio-Medical Signals: Classification, Acquisition and Difficulties during Acquisition. Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retinography Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.

**UNIT–II**

ECG: Measurement of Amplitude and Time Intervals, QRS Detection (Different Methods), ST Segment Analysis, Removal of Baseline Wander and Power line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors.

**UNIT–III**

Data Reduction: TurningPoint algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length. Coding.

**UNIT–IV**

EEG: Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition. Study of pattern of brain waves, Epilepsy-Transition, detection and Estimation. EEG Analysis By Spectral Estimation: The Bt Method, Periodogram, Maximum Entropy Method & AR Method, Moving Average Method. The ARMA Methods, Maximum Likelihood Method.

**UNIT–V**

EP Estimation: by Signal Averaging, Adaptive Filtering:- General Structures of Adaptive filters, LMS Adaptive Filter, Adaptive Noise Cancelling, Wavelet Detection:- Introduction, Detection By Structural features, Matched Filtering, Adaptive Wavelet Detection, Detection of Overlapping Wavelets.

**Books and References:**


1. Willis J. Tomkin, “Biomedical Digital Signal Processing”, PHI.
2. D. C. Reddy, “Biomedical Signal Processing”, McGraw Hill
3. Crommwell Weibel and Pfeifer, “Biomedical Instrumentation and Measurement”, PHI
4. Arnon Cohen, “Biomedical Signal Processing (volume-I)”, Licrc Press\
5. Rangaraj M. Rangayyan, “Biomedical Signal Analysis A Case Study Approach”, John Wiley and Sons Inc.
6. John G. Webster, “Medical instrumentation Application and Design”, John Wiley & Sons Inc

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | ENTREPRENEURSHIP DEVELOPMENT | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the concept and importance of entrepreneurship. |
| **2.** | Learn the skills and competencies required for entrepreneurship. |
| **3.** | Develop a business plan for a startup venture. |
| **4.** | Understand the legal and regulatory framework for entrepreneurship. |
| **5.** | Analyze and evaluate the success factors for entrepreneurship. |

| **Course Outcome (CO):** The Students will be able to | |
|---|---|
| **CO1** | identify and evaluate entrepreneurial opportunities. |
| **CO2** | develop the skills and competencies required for entrepreneurship. |
| **CO3** | create a comprehensive business plan for a startup venture. |
| **CO4** | Understanding of the legal and regulatory framework for entrepreneurship. |
| **CO5** | analyze and evaluate the success factors for entrepreneurship. |

**UNIT–I**

Entrepreneurship- definition. growth of small scale industries in developing countries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types. Government policy for small scale industry; stages in starting a small scale industry.

**UNIT–II**

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

**UNIT–III**

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

**UNIT–IV**

Project Planning and control: The financial functions, cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

**UNIT–V**

Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

**Books and References:**


1. Forbat, John, “Entrepreneurship” New Age International.
2. 2. Havinal, Veerbhadrappa, “Management and Entrepreneurship” New Age International
3. 3. Joseph, L. Massod, “Essential of Management", Prentice Hall of India

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | INTRODUCTION TO SMART GRID | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the concept and significance of Smart Grid. |
| **2.** | Learn about the components and infrastructure of Smart Grid. |
| **3.** | Study the communication and control technologies used in Smart Grid. |
| **4.** | Understand the challenges and opportunities associated with Smart Grid implementation. |
| **5.** | Analyze the impact of Smart Grid on the power industry and society. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Understand the concept and significance of Smart Grid. |
| **CO2** | Learn about the components and infrastructure of Smart Grid. |
| **CO3** | Study the communication and control technologies used in Smart Grid. |
| **CO4** | Understand the challenges and opportunities associated with Smart Grid implementation. |
| **CO5** | Analyze the impact of Smart Grid on the power industry and society. |

**UNIT–I**

**Introduction:** Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid.

**UNIT–II**

**Smart Grid Technologies:** Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation.

**UNIT–III**

**Smart Grid Technologies:** Smart Substations, Substation Automation, Feeder Automation, Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU), PMUs application to monitoring & control of power system.

**UNIT–IV**

**Microgrids and Distributed Energy Resources:** Concept of microgrid, need & application of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Plastic & Organic solar cells, thin flim solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

**UNIT–V**

**Power Quality Management in Smart Grid:** Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring

**Books and References:**


1. Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid:
4. Technology and Applications”, Wiley.
5. Jean Claude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell 19. 6. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC Press.
6. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability”,Artech House Publishers July 2011.
7. James Northcote, Green, Robert G. Wilson “Control and Automation of Electric Power Distribution Systems (Power Engineering)”, CRC Press.
8. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert “SubstationAutomation (Power Electronice and Power Systems)”, Springer
9. R.C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw Hill Publication.

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | QUALITY MANAGEMENT | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand quality concepts and quality management systems. |
| **2.** | Learn statistical process control techniques and quality improvement tools. |
| **3.** | Gain knowledge on Six Sigma, TQM, and Lean methodologies. |
| **4.** | Understand the role of leadership in quality management. |
| **5.** | Develop skills in quality audits, supplier management, and documentation. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Ability to implement quality management systems in organizations. |
| **CO2** | Competence in using statistical process control and quality improvement tools. |
| **CO3** | analyze and improve processes using Six Sigma, TQM, and Lean methodologies. |
| **CO4** | Understanding of the importance of leadership in ensuring quality. |
| **CO5** | conduct quality audits, manage suppliers, and maintain documentation. |

**UNIT–I**

Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type. Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure. Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

**UNIT–II**

Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program. Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

**UNIT–III**

Control Charts, Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Chart, Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts

**UNIT–IV**

Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

**UNIT–V**

ISO-9000 and its concept of Quality Management, ISO 9000 series, Taguchi method, JIT in some details.

**Books and References:**


1. Lt. Gen. H. Lal, “Total Quality Management”, Eastern Limited, .
2. Greg Bounds, “Beyond Total Quality Management”,McGraw Hill
3. Menon, H.G, “TQM in New Product manufacturing”,McGraw Hill

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | INDUSTRIAL OPTIMIZATION TECHNIQUES | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Learn the fundamentals of optimization techniques used in industry. |
| **2.** | Understand the optimization techniques for linear and nonlinear systems. |
| **3.** | Understand the concept of simulation modeling for optimization. |
| **4.** | Study various metaheuristic techniques for optimization. |
| **5.** | Learn about industrial applications of optimization techniques. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Learn the fundamentals of optimization techniques used in industry. |
| **CO2** | Understand the optimization techniques for linear and nonlinear systems. |
| **CO3** | Understand the concept of simulation modeling for optimization. |
| **CO4** | Study various metaheuristic techniques for optimization. |
| **CO5** | Learn about industrial applications of optimization techniques. |

**UNIT–I**

**Linear Programming:** Historical development of optimization, engineering application of optimization, formulation of design problems as a mathematical
programing problem. Graphical method of solution, Simplex method, Dual Simplex method and its application in engineering.

**Transportation and Assignment:** Introduction**,** Mathematical formulations, optimal solution of transportation model. Assignment problems: mathematical formulation, solution of Assignment models (Hungarian method), variation of the Assignment problem, the travelling sales man problem and their application in Engineering.

**UNIT–II**

**Sequencing and Network Analysis:** Introduction of sequencing, General assumptions, n Jobs through 2 machines, n jobs through 3 machines, *n* jobs through *m* machines, 2 jobs through *m* machines and their applications in Engineering.

**Network Analysis:** Introduction**,** Network logic (Network or arrow diagram), Rules for drawing network diagrams, time analysis, forward and backward computation CPM and PERT, and their applications in Engineering.

**UNIT–III**

**Theory of Games and Queueing Models:** Introduction, 2 person zero sum games, Maximin and minimax principle, game with saddle point and without saddle point,
Principle of dominance, Rectangular games, graphical solution of 2xn or mx2 games.

**Queuing model:** Introduction, Application of Queuing model, generalized Poisson queuing model, single server models and multiple channel Queuing modeland their applications in Engineering.

**UNIT–IV**

**Dynamic Programming and Simulation**: Introduction Formulation of Dynamic Programming Problem, Dynamic Programming Algorithm, Forward recursions, Capital Budgeting Problem, Cargo-loading Problem. Solution of LPP by DPP

**Simulation:** Introduction, definition and types of simulation, need for Simulation advantage and disadvantage, application of simulation, simulation procedure, Monte Carlo simulation and their applications in Engineering.

**UNIT–V**

**Inventory Control and Replacement Models:** Introduction, types of inventories, Inventory cost, Deterministic and probabilistic (nondeterministic) inventory models
and their application in engineering.

**Replacement models:** Introduction, definition, Replacement of items that deteriorate, Replacement of items that fail suddenly, Equipment Renewal Problem, Individual and Group Replacement policies & their applications in Engineering

**Text Books:**


1. Singiresu S. Rao. "Engineering Optimization" Theory and Practice". New Age International, New Delhi.
2. R. Panneerselvam. "Operations Research ". Prentice- Hall of India, New Delhi
3. Eliezer Naddor. "Inventory Systems". John Wiley & Sons, Inc. New York


**Reference Books:**


1. H.A. Taha: Operations Research – An Introduction, Macmillan Publishing Company, Inc., New York.
2. K. Swarup, P.K. Gupta, M. Mohan: "Operations Research", Sultan Chand and Sons, New Delhi.
3. P.K. Gupta, D.S. Hira: "Operations Research" – An Introduction, S. Chand & Company Limited, New Delhi.
4. S.S. Rao: "Optimization Theory and Applications", Wiley Eastern Ltd., New Delhi.
5. J.K. Sharma: "Operations Research: Theory and Applications", Mac Millan India

## Semester – VIII : OPEN ELECTIVES III

| Subject Code | VIROLOGY | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

3.

| Course Objective : Students undergoing this course are expected to | |
|---|---|
| 1. | understand the role of viruses in causing diseases. |
| 2. | understand how viruses affect animals and humans. |
| 3. | learn about Small DNA viruses: parvo- and polyoma viruses, and Large DNA viruses: Herpes-adeno-, and poxviruses. |
| 4. | comprehend Retroviruses: structure, classification, life cycle; reverse transcription, HIV, viral pathogenesis, and AIDS. |
| 5. | understand the conventional and modern approaches to vaccine production. |

| Course Outcome (CO):The Students will be able to | |
|---|---|
| CO1 | Understand the diversity, components, and history of viruses. |
| CO2 | Analyze the consequences of virus infection on host macromolecules. |
| CO3 | Demonstrate knowledge of viral diagnostic techniques and counter attack mechanisms. |
| CO4 | Identify and classify different types of viruses and their pathogenesis. |
| CO5 | Evaluate antiviral therapies and modern approaches to virus control. |

**UNIT–I**

General Concepts: Virus history, Diversity, shapes, sizes and components of genomes. Isolation and purification of viruses and components.

**UNIT–II**

Consequences of virus infection to animals and human. Viral infection: affect on host macromolecules. Viral infection: establishment of the antiviral state. Viruses counter attack mechanisms. Viral diagnostic techniques: Rapid Antigen testing, RTPCR.

**UNIT–III**

Classification of viruses and nomenclatures. +strand RNA viruses-Picorna viruses. Flavi viruses- West Nile virus and Dengue virus. Corona viruses- SARS pathogens. Small DNA viruses: parvo- and polyoma viruses. Large DNA viruses: Herpes-adeno-, and poxviruses. Miscellaneous viruses.

**UNIT–IV**

–ve strand RNA viruses Paramyxo viruses. Orthomyxo viruses: Influenza pathogenesis and Bird flu. Rhabdo viruses: Rabies pathogenesis.. dsRNA viruses- Reo viruses. Retroviruses: structure, classification, life cycle; reverse transcription. Retroviruses: HIV, viral pathogenesis and AIDS.

**UNIT–V**

Antivirals and viral vaccines Viral Vaccines Conventional vaccines-killed and attenuated, modern vaccinesrecombinant proteins, subunits, DNA vaccines, peptides, immunemodulators (cytokines), vaccine delivery and adjuvants, large scale manufacturing- QA/QC issues. Antivirals Interferons, designing and screening of antivirals, mechanism of action, antiviral libraries, antiretrovirals-mechanism of action and drug resistance. Modern approaches of virus control Anti-sense RNA, siRNA, ribozymes.

**Books and References:**


**1.** Antiviral Agents, Vaccines and immunotherapies. Stephen K. Tyring. ISBN 9780367393748 CRC

**2.** Basic Virology – Edward K Wanger. Blackwell Publication

**3.** Fundamentals of molecular virology – Acheson and Nicholas H,2011

**4.** Principles of Virology 2nd edition by S.J.Flint, L.W.Enquist, R.M.Krug,V.R. Racaniello, and A.M.Skalka ASM Press

**5.** Medical Virology 4th edition by David O.White and Frank J. Fenner. Academic Press

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | NATURAL LANGUAGE PROCESSING | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Introduce basic concepts in natural language processing (NLP). |
| **2.** | Understand various approaches to language modeling and text representation. |
| **3.** | Learn about the techniques used in semantic analysis and generation. |
| **4.** | Explore advanced NLP topics, such as machine translation and summarization. |
| **5.** | Apply NLP techniques to real-world problems and evaluate performance. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Develop an understanding of NLP concepts and techniques. |
| **CO2** | Learn to analyze and represent natural language text. |
| **CO3** | Gain proficiency in techniques for semantic analysis and generation. |
| **CO4** | Understand the challenges involved in advanced NLP tasks. |
| **CO5** | Apply NLP techniques to solve real-world problems effectively. |

**UNIT–I**

**Introduction to Natural Language Understanding:** The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.

**UNIT–II**

Introduction to semantics and knowledge representation, some applications like machine translation, database interface.

**UNIT–III**

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

**UNIT–IV**

**Grammars for Natural Language:** Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

**UNIT–V**

**Ambiguity Resolution:** Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

**Books and References:**


1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, “NLP: A Paninian Perspective”, Prentice Hall, New Delhi.
2. James Allen, “Natural Language Understanding”, Pearson Education.
3. D. Jurafsky, J. H. Martin, “Speech and Language Processing”, Pearson Education.
4. L. M. Ivansca, S. C. Shapiro, “Natural Language Processing and Language Representation”, AAAI Press, 2000.
5. T. Winograd, Language as a Cognitive Process, Addison-Wesley.

**Semester – VIII : OPEN ELECTIVES III**

| Subject Code | HUMAN VALUES IN MADHYASTH DARSHAN | L:T:P | Credits |
|---|---|---|---|
| BTME-802 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | introduce students to the philosophy of Madhyasth Darshan. |
| **2.** | understand the concept of nature and its different classifications. |
| **3.** | recognize the interconnectedness of humans and nature. |
| **4.** | explore the principles of realizing human goals and prosperity. |
| **5.** | examine the conduct of a realized human being and its implications. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Understand the basics and importance of Madhyasth Darshan. |
| **CO2** | Analyze the submergence of nature in space and its evolution. |
| **CO3** | Recognize human beings as an indivisible part of nature and their purpose. |
| **CO4** | Apply natural, social, and psychological principles for achieving human goals. |
| **CO5** | Develop conduct based on Madhyasth Darshan for a happy life and solving present-day problems. |

**UNIT–I**

**Introduction to Madhyasth Darshan and its Basics**

Need to study Madhyasth Darshan; introduction, basic formulations of the darshan; the complete expanse of study and the natural outcome of living according to the darshan.

**UNIT–II**

**Submergence of Nature in Space**

The ever-present existence in the form of nature submerged in space; nature classified into two categories – material and consciousness, and four orders; the form, property, natural characteristic and self-organization of the four orders, General direction and process of evolution in the nature/ existence.

**UNIT–III**

**Human Being as an indivisible part of Nature**

Human being as an indivisible part of nature; various types (five classes) of human beings; human being in the combination of self and body; purpose of self as realization, prosperity for the body; need of behavior and work for attaining the goals of realization and prosperity

**UNIT–IV**

**Fulfillment of human goal of realization and prosperity**

Following natural, social and psychological principles for actualizing the human goal; form of conducive society and order for such practices, study process- achieving realization through self-study and practice while living in such a society (social order).

**UNIT–V**

**Human Conduct based on Madhyasth Darshan**

Description of such a realized self, continuity of happiness, peace, satisfaction and bliss through realization, conduct of a realized human being. Possibility of finding solutions to present day problems (such as inequality of rich and poor, man and woman etc.) in the light of it.

**Books and References:**


1. Nagraj, A., "Manav Vyavahar Darshan", Jeevan Vidya Prakashan, 3rd edition, 2003
2. Nagraj, A., "Vyavaharvadi Samajshastra", Jeevan Vidya Prakashan, 2nd edition, 2009.
3. Nagraj, A., "Avartanasheel Arthashastra", Jeevan Vidya Prakashan, 1st edition, 1998.
4. Class notes on "Human Values in Madhyasth Darshan" available on www.uhv.org.in
5. PPTs for "Human Values in Madhyasth Darshan" available on www.uhv.org.in
6. Video lectures on "Human Values in Madhyasth Darshan" on AKTU Digital Education (https://www.youtube.com/watch?v=l4x26FPFJYs&t=1558s)

**Semester – VIII: OPEN ELECTIVES IV**

| Subject Code | ELECTRIC VEHICLES | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the concept and history of electric vehicles. |
| **2.** | Learn about the components and architecture of electric vehicles. |
| **3.** | Analyze different types of EV motors and their comparison. |
| **4.** | Understand EV batteries and their selection for EVs. |
| **5.** | Learn about charging system design and its internal components. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Analyze recent developments and trends in EV technology. |
| **CO2** | Compare EVs and IC engine vehicles. |
| **CO3** | Understand the computing needs for autonomy in electric vehicles. |
| **CO4** | Analyze BMS global price trends and efficiency. |
| **CO5** | Design and plan EV charging facilities and integrate energy storage. |

**UNIT–I**

**Introduction of Electric Vehicles:** Concept of Electrified transportation, Past, present status of electric vehicles, Recent developments and trends in electric vehicles, Comparison of EVs and IC Engine vehicles, Understanding electric vehicle components, Basic EV components and architecture, Autonomy and vehicle computing needs.

**UNIT–II**

**Electric Motor Drives for EV applications:** Concept of EV motors, Classification of EV motors, Comparison of Electric motors for EV applications, Recent EV motors, BLDC and SRM, axial flux motor. Introduction to power electronics converters, DC-DC converter, speed control of dc motor, BLDC motor driving schemes.

**UNIT–III**

**EV Batteries and Battery Management System:** EV batteries, Lead Acid batteries – Basics, Characteristics, Lithium batteries- Basics, Characteristics, Selection of battery for EVs, Smart battery pack design, Mechanical and reliability aspects of Li Ion packs, UN38 regulation familiarity, Cell balancing in Li Ion, Battery second life and usage in BESS (energy storage systems). BMS - Global price trends, volumetric and gravimetric efficiency trends

**UNIT–IV**

**Charging system design technology for EV applications:**

Charging system design considerations, AC & DC Charging, Charging methods, On-board/Off-board chargers,Vehicle to charger communication system, OCPP familiarity cloud and device side, metrology, billing and authentication types, understand the computing needs in a charging system, Understand internal major block diagrams and subsystems of low and high power chargers. IEC61850 and 61851 familiarities, IEC61000, 60950/51, IEC62196 key highlights.

**UNIT–V**

**EV Charging Facility Planning:** Identification of EV demand, Impact of EV charging on power grid, Energy generation scheduling, different power sources, centralized charging schemes, Energy storage integration into micro-grid, Overview and applicability of AI for the EV ecosystem, design of V2G aggregator, case studies.

**Books and References:**


1. C.C.Chan, K.T.Chau. Modern Electric Vehicle Technology, Oxford University Press, NY 2001
2. M.Ehsani, Y.Gao, S.E.Gay, A.Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles –Fundamentals, Theory and Design, CRC Press, 2004
3. James Larminie, John Lowry. Electric Vehicle Technology Explained. Wiley 2012
4. NPTEL Course on Electric Vehicles – Part 1 by Dr. Amit Jain, IIT Delhi
5. Tests on Lithium-ion batteries. Available at: https://www.lithium-batterie-service.de/en/un-38.3-test-series
6. Handbook on Battery Energy Storage Systems- ADB, 2018


**Addition Practical Hand (Lab works):**

- **a)** BLDC motor control experiment
- **b)** E-rickshaw commercial BLDC and driver based live demo
- **c)** Charge discharge characteristics of Li-Ion batteries and cells
- **d)** BMS function SoC, SoH and cell balancing demo
- **e)** PFC demo and waveform capture
- **f)** LLC (DCDC) demo and waveform capture
- **g)** CV, CC operation
- **h)** Tear down analysis of DC fast charger and AC fast charger

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | AUTOMATION AND ROBOTICS | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Introduce concepts, types, and principles of automation in manufacturing. |
| **2.** | Study elements of fluid power and its application in pneumatics and hydraulics systems. |
| **3.** | Analyze and design automated flow lines, single and mixed model production lines, and CNC machine tools. |
| **4.** | Understand robot classification, components, kinematics, and power transmission systems. |
| **5.** | Learn robot simulation methods, programming, applications in manufacturing, and cell design. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Understand the advantages, goals, and laws of automation and elements of fluid power. |
| **CO2** | Identify the classification and types of automatic transfer machines and design production lines. |
| **CO3** | Apply CNC machine tools and analyze robot kinematics, power transmission, and end effectors. |
| **CO4** | Implement robot simulation methods and program robots for manufacturing operations. |
| **CO5** | Design and control robot cells for various applications and understand their limitations. |

**UNIT–I**

**Automation:** Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation. Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

**UNIT–II**

**Manufacturing Automation:** Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimode and mixed model production lines. Programmable Manufacturing Automation CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations.

**UNIT–III**

**Robotics:** Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source. Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.

**UNIT–IV**

**Robot Drives and Power Transmission Systems:** Robot drive mechanisms: Hydraulic/Electric/Pneumatics, servo & stepper motor drives, Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings. Robot end Effectors: Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for rippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

**UNIT–V**

**Robot Simulation:** Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming. Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.

**Books and References:**


1. An Introduction to Robot Technology, by Coifet Chirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
6. Industrial Robots, by Groover, McGraw Hill.
7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.
8. Robots & Manufacturing Automation, by Asfahl, Wiley.

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | COMPUTERIZED PROCESS CONTROL | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the role and benefits of computers in process control. |
| **2.** | Learn about the different elements and architectures of computer-aided process control systems. |
| **3.** | Gain knowledge of industrial communication systems and data transfer techniques. |
| **4.** | Develop skills in process modeling and control model formulation. |
| **5.** | Learn advanced strategies for computerized process control and their real-world examples. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Ability to design and implement computer-aided process control systems. |
| **CO2** | Understanding of the economic benefits and real-world applications of computerized process control. |
| **CO3** | Proficiency in using industrial communication systems and computer control process software. |
| **CO4** | develop and validate process models for effective process control. |
| **CO5** | Knowledge of advanced control strategies and their application in various industries. |

**UNIT–I**

Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer–Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.

**UNIT–II**

Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System.

**UNIT–III**

Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation.

**UNIT–IV**

Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.

**UNIT–V**

Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.

**Books and References:**


1. S. K. Singh, “Computer Aided Process control”, PHI.
2. C. L. Smith, “Digital computer Process Control”, Ident Educational Publishers.
3. C. D. Johnson, “Process Control Instrumentation Technology”, PHI.
4. Krishan Kant, “Computer Based Industrial Control”
5. Pradeep B. Deshpande & Raymond H. Ash, “Element of Computer Process Control with Advance Control Applications”, Instrument Society of America, 1981.
6. C. M. Houpis & G. B. Lamond, “Digital Control System Theory”,McGraw Hill.

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | DATA WAREHOUSING & DATA MINING | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the concept and components of Data Warehousing. |
| **2.** | Familiarize with Data Warehouse process, technology and schema design. |
| **3.** | Learn the principles and techniques of Data Mining. |
| **4.** | Understand classification and clustering algorithms. |
| **5.** | Learn how to visualize data and its overall perspective. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | design and build a Data Warehouse. |
| **CO2** | implement Data Warehouse process and technology. |
| **CO3** | preprocess data and perform Data Mining. |
| **CO4** | apply classification and clustering algorithms. |
| **CO5** | visualize data and provide insights to stakeholders. |

**UNIT–I**

**Data Warehousing**:

Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept.

**UNIT–II**

**Data Warehouse Process and Technology:**

Warehousing Strategy, Warehouse /management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/Server Computing Model & Data Warehousing. Parallel Processors & Cluster Systems, Distributed DBMS implementations, Warehousing Software, Warehouse Schema Design

**UNIT–III**

**Data Mining**:

Overview, Motivation, Definition & Functionalities, Data Processing, Form of Data Pre-processing, Data Cleaning: Missing Values, Noisy Data, (Binning, Clustering, Regression, Computer and Human inspection), Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Discretization and Concept hierarchy generation, Decision Tree

**UNIT–IV**

**Classification:**

Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases, Statistical- Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms.

**Clustering**:
Introduction, Similarity and Distance Measures, Hierarchical and Partitional Algorithms. Hierarchical Clustering- CURE and Chameleon. Density Based Methods DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method – Statistical Approach, Association rules: Introduction, Large Item sets, Basic Algorithms, Parallel and Distributed Algorithms, Neural Network approach.

**UNIT–V**

**Data Visualization and Overall Perspective**:
Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, TestingData Warehouse. Warehousing applications and Recent Trends: Types of Warehousing Applications, Web Mining, Spatial Mining and Temporal Mining.

**Books and References:**


1. Alex Berson, Stephen J. Smith "Data Warehousing, Data-Mining & OLAP", Mc GrawHil.
2. Mark Humphries, Michael W. Hawkins, Michelle C. Dy, "Data Warehousing: Architecture and Implementation", Pearson Education..
3. I. Singh, "Data Mining and Warehousing", Khanna Publishing House.
4. Margaret H. Dunham, S. Sridhar ,"Data Mining: Introductory and Advanced Topics" Pearson Education.

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | DIGITAL AND SOCIAL MEDIA MARKETING | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the shift from traditional marketing practices to digital marketing practices. |
| **2.** | Learn marketing strategies and practices for the digital world. |
| **3.** | Gain knowledge about social media marketing channels and their advertising campaigns. |
| **4.** | Learn to acquire and engage users through digital channels using various tools and techniques. |
| **5.** | Explore digital transformation, innovation, and trends in the global and Indian context. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | develop digital marketing strategies and practices. |
| **CO2** | create and manage social media campaigns. |
| **CO3** | acquire and engage users through various digital channels. |
| **CO4** | evaluate the effectiveness of digital marketing strategies. |
| **CO5** | understand digital transformation, innovation, and trends in the global and Indian context. |

**UNIT–I**

Introduction to Digital Marketing: The new digital world - trends that are driving shifts from traditional marketing practices to digital marketing practices, the modern digital consumer and new consumer's digital journey. Marketing strategies for the digital world-latest practices.

**UNIT–II**

Social Media Marketing -Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post, Content Planning and writing. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns.

**UNIT–III**

Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing. Marketing gamification, Online campaign management; using marketing analytic tools to segment, target and position; overview of search engine optimization (SEO).

**UNIT–IV**

Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies.

**UNIT–V**

Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing Understanding trends in digital marketing – Indian and global context, online communities and co-creation.

**Books and References:**


1. Moutsy Maiti: Internet Mareting, Oxford University Press India
2. Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
3. Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts
4. Share the Formula for Tangible Returns on Your Marketing Investment; McGraw-Hill Professional.
5. Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page.
6. Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | MODELING OF FIELD-EFFECT NANO DEVICES | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the fundamentals of MOSFET scaling and short channel effects. |
| **2.** | Analyze the impact of channel engineering and source/drain engineering on device performance. |
| **3.** | Explore the design of multigate transistors and their advantages over single gate MOSFETs. |
| **4.** | Evaluate the characteristics of silicon nanowire and carbon nanotube MOSFETs, as well as molecular transistors. |
| **5.** | Investigate the effects of radiation on SOI MOSFETs and the design of digital, analog, and RF circuits using nano devices. |

| **Course Outcome (CO):** The Students will be able to | |
|---|---|
| **CO1** | Develop models for MOS electrostatics and analyze MOSFET current-voltage characteristics. |
| **CO2** | Design double gate MOS systems and analyze their performance using various parameters. |
| **CO3** | Understand the characteristics and design of carbon nanotube and molecular transistors. |
| **CO4** | Analyze the effects of radiation on SOI MOSFETs and the performance tradeoffs in digital and analog circuit design. |
| **CO5** | Apply the knowledge gained in the course to develop new and innovative field-effect nano devices. |

**UNIT–I**

MOSFET scaling, short channel effects - channel engineering - source/drain engineering - high k dielectric - copper interconnects -strain engineering, SOI MOSFET, multigate transistors – single gate – double gate – triple gate – surround gate, quantum effects – volume inversion – mobility – threshold voltage – inter subband scattering, multigate technology – mobility – gate stack.

**UNIT–II**

MOS Electrostatics – 1D – 2D MOS Electrostatics, MOSFET Current- Voltage Characteristics – CMOS Technology – Ultimate limits, double gate MOS system – gate voltage effect - semiconductor thickness effect – asymmetry effect – oxide thickness effect – electron tunnel current – two dimensional confinement, scattering – mobility.

**UNIT–III**

Silicon nanowire MOSFETs – Evaluvation of I-V characteristics – The I-V characteristics for nondegenerate carrier statistics – The I-V characteristics for degenerate carrier statistics – Carbon nanotube –Band structure of carbon nanotube – Band structure of graphene – Physical structure of nanotube – Band structure of nanotube – Carbon nanotube FETs – Carbon nanotube MOSFETs – Schottky barrier carbon nanotube FETs – Electronic conduction in molecules – General model for ballistic nano transistors – MOSFETs with 0D, 1D, and 2D channels – Molecular transistors – Single electron charging – Single electron transistors.

**UNIT–IV**

Radiation effects in SOI MOSFETs, total ionizing dose effects – single-gate SOI – multi-gate devices, single event effect, scaling effects.

**UNIT–V**

Digital circuits – impact of device performance on digital circuits – leakage performance trade off – multi VT devices and circuits –SRAM design, analog circuit design – trans conductance - intrinsic gain – flicker noise – self heating –band gap voltage reference – operational amplifier –comparator designs, mixed signal – successive approximation DAC, RF circuits.

**Books and References:**


1. J P Colinge, "FINFETs and other multi-gate transistors", Springer – Series on integrated circuits and systems, 2008
2. Mark Lundstrom, Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006
3. M S Lundstorm, "Fundamentals of Carrier Transport", 2nd Ed., Cambridge University Press, Cambridge UK, 2000

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | MODELLING AND SIMULATION OF DYNAMIC SYSTEMS | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Introduce the concepts of modeling and simulation of dynamic systems |
| **2.** | Understand bond graph modeling and its application in mechanical, thermal, hydraulic, and electrical systems |
| **3.** | Explore system models of combined systems and their linearity/non-linearity |
| **4.** | Study dynamic response and system transfer functions, and analyze their performance measures |
| **5.** | Learn simulation techniques and applications using SIMULINK and optimization techniques. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Ability to model and simulate dynamic systems using MATLAB and Bond Graph modeling |
| **CO2** | Proficiency in modeling mechanical, thermal, hydraulic, and electrical systems using Bond Graph modeling |
| **CO3** | Understanding of combined system models and linearity/non-linearity of the systems |
| **CO4** | analyze and evaluate dynamic response and system transfer functions and their performance measures |
| **CO5** | Proficiency in using SIMULINK for simulation, validation and verification of simulation models, and optimization techniques for system identifications. |

**UNIT–I**

I**ntroduction to modeling and simulation:** Introduction to modeling, Examples of models, modeling of dynamic system, Introduction to simulation, MATLAB as a simulation tool, Bond graph modeling, causality, generation of system equations.

**UNIT–II**

**Bond graph modeling of dynamic system:** Methods of drawing bond graph model- Mechanical systems & Electrical systems, some basic
system models- Mechanical systems, Thermal systems, hydraulic systems, pneumatic systems and electrical systems.

**UNIT–III**

**System models of combined systems:** Linearity and non linearity in systems combined rotary and translatory system, electro mechanical
system, hydro- mechanical system.

**UNIT–IV**

**Dynamic Response and System Transfer Function:** Dynamic response of 1st order system and 2nd order system, performance measures for 2nd order system, system transfer function, transfer function of 1st and 2nd order system Block diagram algebra, signal flow diagram, state variable formulation, frequency response and bode plots.

**UNIT–V**

**Simulation and simulation applications:** Simulation using SIMULINK, examples of simulation problems- simple and the compound pendulum, planner mechanisms, validation and verification of the simulation model, parameter estimation methods, system identifications, introduction to optimization.

**Books and References:**


1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2nd Edition. Academic press 2000.
2. Robert L. Woods, Kent L. Lawrence, “Modeling and simulation of dynamic systems”, Person, 1997.
3. Brown, Forbes T. “Engineering System Dynamics”, New York, NY: CRC, 2001. ISBN: 9780824706166.
4. Pratab.R " Getting started with MATLAB" Oxford university Press 2009.

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | BIG DATA | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand the concept of Big Data and its importance. |
| **2.** | Gain knowledge about the Hadoop ecosystem and its components. |
| **3.** | Learn about HDFS and its architecture, design, and implementation. |
| **4.** | Understand the basics of NoSQL databases and Spark. |
| **5.** | Gain knowledge about Hadoop Eco System Frameworks like Pig, Hive, and HBase. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | identify and analyze Big Data-related problems. |
| **CO2** | work with Hadoop ecosystem components and analyze data using Hadoop. |
| **CO3** | understand HDFS architecture, design, and implementation. |
| **CO4** | work with NoSQL databases and Spark. |
| **CO5** | work with Hadoop Eco System Frameworks like Pig, Hive, and HBase. |

**UNIT–I**

**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.

**UNIT–II**

**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System.

**Map-Reduce:** Map-Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce

**UNIT–III**

**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: Compression, serialization, Avro and file-based data structures. Hadoop Environment: Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud

**UNIT–IV**

**Hadoop Eco System and YARN:** Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features – Name Node high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN.

**NoSQL** Databases: Introduction to NoSQL MongoDB: Introduction, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections

**Spark**: Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed Databases, anatomy of a Spark job run, Spark on YARN

**SCALA:** Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.

**UNIT–V**

**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase

**Pig** : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators,

**Hive** - Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries.

**HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.

**Books and References:**


1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Big-Data Black Book, DT Editorial Services, Wiley.
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, “Big Data Fundamentals: Concepts, Drivers and Techniques”, Prentice Hall.

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | HUMAN VALUES IN BAUDDHA AND JAIN DARSHAN | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Understand basics, principles and scope of Bauddha and Jain Darshan |
| **2.** | Define key terms of Bauddha and Jain Darshan |
| **3.** | Examine purpose and program for human beings based on these Darshans |
| **4.** | Analyze basic principles and realities of Jain Darshan |
| **5.** | Evaluate solutions to present day problems in the light of Darshans |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Knowledge of Bauddha and Jain Darshan basics, principles and scope |
| **CO2** | Ability to define key terms of Bauddha and Jain Darshan |
| **CO3** | Understanding of purpose and program for human beings based on these Darshans |
| **CO4** | Analysis of basic principles and realities of Jain Darshan |
| **CO5** | Evaluation of solutions to present day problems in the light of Darshans. |

**UNIT–I**

**Introduction to Bauddha and Jain Darshan and their Basics**

Need to study Bauddha and Jain Darshan; the origin of the these philosophies, their basic principles and scope for further reading.

**UNIT–II**

**Basic Principles of Bauddha Darshan**

law of impermanence (changability); four noble truths; eightfold path; law of cause- action (pratitya-samutpaad)

Definition of some salient words of Buddha Darshan – nirvana, dhamma, tri- ratna(Buddha, Dharma and Sangh), pragya, karma, parmi, ashta-kalap, trishna, shad-ayatan, samvedana, vipassana, anitya, maitri, brham-vihaar, tathagata, arahant..

**UNIT–III**

**Purpose and Program for a Human Being based on Bauddha Darshan** The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition.

Purpose-freedom from suffering, nirvana; root of suffering- vikaar – raga, dvesha and moha, Progam – various steps of meditation for attaining knowledge; shamath and vipassana; sheel- samadhi-pragya; practice of equanimity (samatva),eightfold path (Ashtang Marg); combination of understanding and practice..

**UNIT–IV**

**Basic Principles of Jain Darshan**

Basic realities – description of nine elements in existence (jeev, ajeev, bandh, punya, paap, aashrav, samvar, nirjara, moksha), 6 dravya of lok – dharma, adhrma, akash, kaal, pudgal, jeev; tri-lakshan, various types of pragya, various stages of realisation; samyak-gyan, samyak- darshan, samyak-charitra, syadvaad, anekantavaad, naya- nishchaya and vyavahar, karma- phal siddhanta

Definition of some salient words of Jain Darshan –arhant, jin, tirthankara, panch- parameshthi, atma,

pramaan, kaal, pudgal, paramanu, kashay, leshya..

**UNIT–V**

**Purpose and Program for a Human Being based on Jain Darshan**

The purpose and program of a human being living on the basis of it, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition, possibility of finding solutions to present day problems in the light of it.

Purpose (goal) - moksha, Program- following mahavrat, anuvrat, 10 lakshan dharma; samyak darshan-gyan-charitra. Commonality with Bauddha Darshan

**Text Books:**


**1.** Chattejee, S.G. and Datta, D.M., "An Introduction to Indian Philosophy", University of Calcutta Press, 1960..


**Reference Books:**


**1.** "Dhammapad", Vipassana Research Institute, 2001.
**2.** Drukpa, G., "Musings from the Heart", Drukpa Publications Private Ltd, 2018.
**3.** Jyot, "Ek cheez milegi Wonderful", A Film Directed by Jyot Foundation, 2013.
**4.** Goenka, S.N., "The Discourse Summaries", Vipassana Research Institute, 1987.
**5.** Madhavacharya, "Sarva-darshan Samgraha", Chaukhambha Vidya Bhavan, Varanasi, 1984.
**6.** Varni, J., "Samansuttam", Sarva Seva Sangh Prakashan, Varanasi, 7th Edition, 2010.
**7.** https://www.youtube.com/watch?v=cz7QHNvNFfA&list=PLPJVlVRVmhc4Z01fD57jbzycm9I6W054x (English)
**8.** https://www.youtube.com/watch?v=r5bud1ybBDc&list=PLY9hraHvoLQLCkl7Z2DWKMgRAWU77bKFy (Hindi).

**Semester – VIII : OPEN ELECTIVES IV**

| Subject Code | HUMAN VALUES IN VEDIC DARŚANA | L:T:P | Credits |
|---|---|---|---|
| BTME-803 | | 3:1:0 | 03 |

| **Course Objective :** Students undergoing this course are expected to | |
|---|---|
| **1.** | Introduce students to Vedic and Nyaya Darshan philosophy. |
| **2.** | Teach the principles of Vaisesika Darshan philosophy. |
| **3.** | Explain the concepts of Samkhya-Yoga Darshan and Vedanta Darshan. |
| **4.** | Familiarize students with the Upanishads and the philosophy of God. |
| **5.** | Help students understand the purpose and program of human life. |

| **Course Outcome (CO):**The Students will be able to | |
|---|---|
| **CO1** | Understand the basic principles of Vedic and Nyaya Darshan. |
| **CO2** | Analyze the principles of Vaisesika Darshan and apply them. |
| **CO3** | Analyze the concepts of Samkhya-Yoga Darshan and Vedanta Darshan and apply them. |
| **CO4** | Understand the Upanishads and the philosophy of God. |
| **CO5** | Understand the purpose and program of human life and apply it. |

**UNIT–I**

**Introduction to Vedic Darśana and Nyāya Darśana (Philosophy of Indian Logic and Reasoning)**

Introduction to Vedic literature, need to study Vedic Darśana; its origin and subject matter. Introduction to Nyāya Darśana, 16 padārthas (pramāṇa, prameya, saṃśaya, prayojana, dṛṣṭānta, siddhānta, avayava, tarka, nirṇaya, vāda, jalpa, vitaṇḍā, hetuābhāsa, chala, jāti, nigrahasthāna) paṃcāvayava prakriyā (pratijñā, hetu, udāharaṇa, upanaya, nigamana).

**UNIT–II**

**Vaiśeṣika Darśana (Philosophy of Matter)**

Introduction to Vaiśeṣika Darśana, definition of Dharma, abhyudaya, niḥśreyasa; 6 padārthas (dravya, guṇa, karma, sāmānya, viśeśa, samavāya) – their definition, characteristics and relationship; nitya-anitya; cause-effect relationships; dṛṣṭa-adṛṣṭa karma phala; mindful dāna; śucitā-aśucitā; reasons of rāga-dveśa, avidyā, sukha-duḥkha, etc. and how to get rid of them.

**UNIT–III**

**Sāṃkhya-Yoga Darśana (Philosophy of Spirituality)**

Sāṃkhya Darśana- Puruṣārtha, the nature of Puruṣa and Prakṛti, 24 elements of Prakṛti, bondage and salvation (liberation), the principle of satkāryavāda, triguṇātmaka prakṛti.Yoga Darśana- the steps of Aṣṭāṃga yoga (yama, niyama, āsana, prāṇāyāma, pratyāhāra, dhāraṇā, dhyāna and samādhi) and the challenges in following them, afflictions (kleṣa)- avidyā, asmitā, rāga, dveṣa, abhiniveśa, different types of vṛttis (pramāṇa, viparyaya, vikalpa, nidrā, smṛti), the process of nirodha of vṛttis; maitri, karuṇā, muditā, upekṣā; description of yama, niyama, āsana and praṇayāma; kriyāyoga– tapa, svādhyāya and īśvara-praṇidhāna; different steps of samādhi, different types of saṃyama, vivekakhyāti, prajñā.

**Vedanta Darshan**

Vedanta Darshan- Nature of Brahma and Prakriti, Methods of Upasana; adhyasaand sanskar; nature of Atma, description of existence, principle of karma-phala, description o pancha kosha, different nature of paramatma/brahma, Ishwar, Four qualifications (Sadhan chatushtay).

**UNIT–IV**

**Upaniṣad and Vedanta Darśana (Philosophy of God)**

Introduction to Upaniṣads and Vedanta Darśana; Īśopaniṣad – Idea of renouncement, Karma Yoga, balance of Vidyā-Avidyā and Prakṛti-Vikṛti; Tattirīyopaniṣad – Different names of the God and their meaning, parting message of Guru to the graduating student (Śikṣāvallī), Nature of Brahma and Prakṛti, Methods of Upāsanā; Nature of Ātmā, Description of existence, principle of karma-phala, description of paṃca kośa, nature of mukti , process and way to achieve it, antaḥkaraṇa-śuddhi, different characteristics of paramātmā/brahma, Īśvara, Four qualifications (Sādhana-catuṣṭaya)

**UNIT–V**

**Purpose and Program for a Human Being based on the Vedic Darśana**

The purpose and program of a human being living on the basis of the Vedic Darśana, clarity and practice of human values and human conduct, the natural outcome of such a program on society, nature and tradition. Vedic system of living in a society - the idea of vratas and varaṇa (freedom of choice with commitment), Varṇa System, Āśrama System, Paṃca Mahāyajṇa, 16 Saṃskāras, etc.

**Books and References:**


1. Acharya Udayveer Shastri, Sankhya Darshanam (vidyodayaBhashyam), Govindram Hasanand.
2. Acharya Rajveer Shastri, Patanjal Yog Darśana Bhashyam, Arsha Sahitya Prachar Trust.
3. Acharya Udayveer Shastri, Brahma Sutra (Vedanta Darshanam), Govindram Hasanand.
4. Krishna, I. (2010) The SāṃkhyaKarika, BharatiyaVidyaPrakashan, 4th edition
5. Madhavacharya, Sarva-DarshanaSamgrah ChaukhambhaVidyabhavan,Varanasi.
6. Muller, F.M. (1928) The Six Systems of Indian Philosophy, London: Longmans Green and Co. Publication.
7. Maharaj O. () PatanjalYogpradeep, Geeta press Gorakhpur
8. Vachaspati M. Sankhyatatvakaumudi, Motilal Banarasi Das Publication
9. Shreemad Bhagwat geeta
10. Shankaracharya, VivekChoodamani
11. Rajyoga, Swami Shivananda
12. The Nyāya Sutras of Gotama, Sinha, N. (Ed.). Motilal Banarsidass Publ. (1990).
13. Pandit Madanmohan Vidyasagar. Sanskar Samuchaya, Vijaykumar Govindram Hasanand. 1998
14. Vedic Vision: Ancient Insights Into Modern Life, Satyavrata Siddhantalankar, Vijay Krishn Lakhanpal, 1999
15. Sanskar Chandrika (Hindi), Dayananda Saraswati, and Satyavrata Siddhantalankar. Vijay Krishn Lakhanpal, (1990).
16. THE TAITTIRIYA Upanishad, Achari, Sri Rama Ramanuja. (2013).
17. Vedic religion: The Taittiriya-Upanishad with the commentaries of Sankaracharya Suresvaracharya and Sayana (Vidyarana). Sastri, A. Mahadeva.(2016).
18. Taittiriyopanishad Sankara Bhashya With Hindi Translation Gita Press 1936.
19. Gautama's Nyāyasūtras: With Vātsyāyana-Bhāṣya. Jha, Ganganatha, ed. Oriental Book Agency, 1939.
20. NyayaDarshnam, Acharya Udayveer Shastri, Vijaykumar Govindram Hasanand (2018)
21. VaisheeshikaDarshanam, Acharya Udayveer Shastri, Vijaykumar Govindram Hasanand(2017)
22. Chattejee, S.G. and Datta, D.M. (1960) An Introduction to Indian Philosophy,Calcutta: University of Calcutta Press.
23. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2019 Second Revised Edition), Excel Books, New Delhi [ISBN 978-93-87034-47-1].
24. Class notes on "Human Values in Vedic Darśana" available on www.uhv.org.in
25. PPTs for "Human Values in Vedic Darśana" available on www.uhv.org.in