# GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)
Coimbatore - 641 013

## Curriculum For

# M. E. THERMAL ENGINEERING

# 2023

## Regulations

**OFFICE OF THE CONTROLLER OF EXAMINATIONS**
**GOVERNMENT COLLEGE OF TECHNOLOGY**
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# GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

**VISION**

To create outstanding Mechanical Engineers with strong domain knowledge and skills capable of working in an Interdisciplinary environment with exemplary ethical values contributing to society through Innovation, Entrepreneurship and Leadership.

**MISSION**

- To develop in each student, a strong theoretical and practical knowledge, a global outlook for a sustainable future and problem solving skills.
- To make productive members of interdisciplinary teams, capable of adapting to changing environments of Engineering, technology and society.
- To inculcate critical thinking abilities among students to enhance innovative ideas and entrepreneurial skills, leadership qualities.
- To imbibe moral and ethical values along with leadership qualities in students.

**GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013**
**M.E. THERMAL ENGINEERING**

## FIRST SEMESTER

| Sl. No. | Course Code | Course Title | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| **THEORY** | | | | | | | | | | |
| 1 | 23TEFCZ1 | RESEARCH METHODOLOGY AND IPR (Common to all branches) | FC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 23TEFC02 | ADVANCED MATHEMATICS FOR THERMAL ENGINEERING | FC | 40 | 60 | 100 | 3 | 1 | 0 | 4 |
| 3 | 23TEPC01 | ADVANCED THERMODYNAMICS | PC | 40 | 60 | 100 | 3 | 1 | 0 | 4 |
| 4 | 23TEPC02 | ADVANCED FLUID DYNAMICS | PC | 40 | 60 | 100 | 3 | 1 | 0 | 4 |
| 5 | 23TEPEXX | PROFESSIONAL ELECTIVE I | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 6 | 23TEPEXX | PROFESSIONAL ELECTIVE II | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 7 | 23TEACXX | AUDIT COURSE I | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| **PRACTICAL** | | | | | | | | | | |
| 8 | 23TEPC03 | ADVANCED IC ENGINES AND SIMULATION LABORATORY | PC | 60 | 40 | 100 | 0 | 0 | 4 | 2 |
| **TOTAL** | | | | **340** | **460** | **800** | **20** | **3** | **4** | **23** |

## SECOND SEMESTER

| Sl. No. | Course Code | Course Title | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| **THEORY** | | | | | | | | | | |
| 1 | 23TEPC04 | ADVANCED HEAT AND MASS TRANSFER | PC | 40 | 60 | 100 | 3 | 1 | 0 | 4 |
| 2 | 23TEPC05 | COMPUTATIONAL FLUID DYNAMICS | PC | 40 | 60 | 100 | 3 | 1 | 0 | 4 |
| 3 | 23TEPC06 | FUEL CELL TECHNOLOGY | PC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 4 | 23TEPC07 | MANUFACTURING AND TESTING OF IC ENGINES AND COMPONENTS | PC | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 5 | 23TEPEXX | PROFESSIONAL ELECTIVE III | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 6 | 23TEACXX | AUDIT COURSE II | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| **PRACTICAL** | | | | | | | | | | |
| 7 | 23TEPC08 | ADVANCED COMBUSTION LABORATORY | PC | 60 | 40 | 100 | 0 | 0 | 4 | 2 |
| 8 | 23TEEE01 | MINI PROJECT | EE | 40 | 60 | 100 | 0 | 0 | 4 | 2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **TOTAL** | **340** | **460** | **800** | **17** | **2** | **8** | **21** |

**GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013**
**B.E.MECHANICAL ENGINEERING**

## THIRD SEMESTER

| Sl No | Course Code | Course Title | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| **THEORY** | | | | | | | | | | |
| 1 | 23TEPEXX | PROFESSIONAL ELECTIVE IV | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 23$$OEXX | OPEN ELECTIVE | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | | | | | | |
| 3 | 23TEEE02 | INTERNSHIP / INDUSTRIAL TRAINING | EEC | 100 | - | 100 | 0 | 0 | * | 2 |
| 4 | 23TEEE03 | PROJECT PHASE I | EEC | 100 | 100 | 200 | 0 | 0 | 12 | 6 |
| **TOTAL** | | | | **280** | **220** | **500** | **6** | **0** | **12** | **14** |

*** Internship / Industrial Training Four Weeks**

## FOURTH SEMESTER

| Sl No | Course Code | Course Title | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| **THEORY** | | | | | | | | | | |
| 1 | 23TEEE04 | PROJECT PHASE II | EEC | 200 | 200 | 400 | 0 | 0 | 24 | 12 |
| **TOTAL** | | | | **200** | **200** | **400** | **0** | **0** | **24** | **12** |

**TOTAL NO. OF CREDITS: 70**

## LIST OF EMPLOYABILITY ENHANCEMENT COURSE

| S. No | Course Code | Course Title | Category | Continuous Assessment Marks | End Sem Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 23TEEE01 | MINI PROJECT | EEC | 40 | 60 | 100 | 0 | 0 | 4 | 2 |
| 2 | 23TEEE02 | INDUSTRIAL TRAINING | EEC | 100 | - | 100 | 0 | 0 | * | 2 |
| 3 | 23TEEE03 | PROJECT PHASE I | EEC | 100 | 100 | 200 | 0 | 0 | 12 | 6 |
| 4 | 23TEEE04 | PROJECT PHASE II | EEC | 200 | 200 | 400 | 0 | 0 | 24 | 2 |
| TOTAL | | | | 440 | 360 | 800 | 0 | 0 | 40 | 12 |

*** Internship / Industrial Training Four Weeks**

**LIST OF PROFESSIONAL ELECTIVE**

| S. No | Course Code | Course Title | Category | Continuous Assessment Marks | End Sem Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|---|---|---|---|
| **PROFESSIONAL ELECTIVE I** | | | | | | | | | | |
| 1 | 23TEPE01 | THERMODYNAMICS AND COMBUSTION | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 23TEPE02 | ARTIFICIAL INTELLIGENCE IN THERMAL SYSTEMS | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 3 | 23TEPE03 | ADVANCED GAS TURBINES | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 4 | 23TEPE04 | DESIGN OF CONDENSERS, EVAPORATORS AND COOLING TOWERS | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 5 | 23TEPE05 | INSTRUMENTATION IN THERMAL ENGINEERING | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **PROFESSIONAL ELECTIVE II** | | | | | | | | | | |
| 6 | 23TEPE06 | ENGINE ELECTRONICS | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 7 | 23TEPE07 | FINITE ELEMENT METHODS IN THERMAL ENGINEERING | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 8 | 23TEPE08 | ADVANCED GAS DYNAMICS AND SPACE PROPULSION | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 9 | 23TEPE09 | STEAM ENGINEERING | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 10 | 23TEPE10 | SUPERCHARGING AND SCAVENGING | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **PROFESSIONAL ELECTIVE III** | | | | | | | | | | |
| 11 | 23TEPE11 | REFRIGERATION AND CRYOGENICS | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 12 | 23TEPE12 | THERMAL ENERGY SYSTEMS | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 13 | 23TEPE13 | ENGINE POLLUTION AND CONTROL | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 14 | 23TEPE14 | AIR CONDITIONING SYSTEM DESIGN | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 15 | 23TEPE15 | SOLAR ENERGY AND WIND ENERGY | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| **PROFESSIONAL ELECTIVE IV** | | | | | | | | | | |
| 16 | 23TEPE16 | BIO-ENERGY CONVERSION TECHNIQUES | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 17 | 23TEPE17 | ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 18 | 23TEPE18 | MODELING OF CI ENGINE PROCESSES | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 19 | 23TEPE19 | ENERGY AUDITING AND MANAGEMENT | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 20 | 23TEPE20 | ELECTRIC AND HYBRID VEHICLES | PE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |

## LIST OF OPEN ELECTIVE COURSES

| Sl. No | Course Code | Course Title | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | L | T | P | C |
| 1 | 23SEOE01 | BUILDING BYE-LAW AND CODES OF PRACTICE | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 2 | 23SEOE02 | PLANNING OF SMART CITIES | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 3 | 23SEOE03 | GREEN BUILDING | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 4 | 23EEOE04 | ENVIRONMENT HEALTH AND SAFETY MANAGEMENT | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 5 | 23EEOE05 | CLIMATE CHANGE AND ADAPTATION | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 6 | 23EEOE06 | WASTE TO ENERGY | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 7 | 23GEOE07 | ENERGY IN BUILT ENVIRONMENT | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 8 | 23GEOE08 | EARTH AND ITS ENVIRONMENT | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 9 | 23GEOE09 | NATURAL HAZARD AND MITIGATION | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 10 | 23EDOE10 | BUSINESS ANALYTICS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 11 | 23EDOE11 | INTRODUCTION TO INDUSTRIAL SAFETY | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 12 | 23EDOE12 | OPERATIONS RESEARCH | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 13 | 23MFOE13 | OCCUPATIONAL HEALTH AND SAFETY | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 14 | 23MFOE14 | COST MANAGEMENT OF ENGINEERING PROJECTS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 15 | 23MFOE15 | COMPOSITE MATERIALS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 16 | 23TEOE16 | GLOBAL WARMING SCIENCE | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 17 | 23TEOE17 | INTRODUCTION TO NANO ELECTRONICS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 18 | 23TEOE18 | GREEN SUPPLY CHAIN MANAGEMENT | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 19 | 23PSOE19 | DISTRIBUTION AUTOMATION SYSTEM | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 20 | 23PSOE20 | ELECTRICITY TRADING & ELECTRICITY ACTS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 21 | 23PSOE21 | MODERN AUTOMOTIVE SYSTEMS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 22 | 23PEOE22 | VIRTUAL INSTRUMENTATION | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 23 | 23PEOE23 | ENERGY MANAGEMENT SYSTEMS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 24 | 23PEOE24 | ADVANCED ENERGY STORAGE TECHNOLOGY | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 25 | 23AEOE25 | DESIGN OF DIGITAL SYSTEMS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 26 | 23AEOE26 | BASICS OF NANO ELECTRONICS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 27 | 23AEOE27 | ADVANCED PROCESSOR | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 28 | 23VLOE28 | HDL PROGRAMMING LANGUAGES | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 29 | 23VLOE29 | CMOS VLSI DESIGN | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 30 | 23VLOE30 | HIGH LEVEL SYNTHESIS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 31 | 23CSOE31 | ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 32 | 23CSOE32 | COMPUTER NETWORK ENGINEERING | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |
| 33 | 23CSOE33 | BIG DATA ANALYTICS | OE | 40 | 60 | 100 | 3 | 0 | 0 | 3 |

## LIST OF AUDIT COURSE

| S. No | Course Code | Course Title | Category | Continuous Assessment Marks | End Sem Marks | Total Marks | L | T | P | C |
|---|---|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | | | |
| 1 | 23TEACZ1 | ENGLISH FOR RESEARCH PAPER WRITING | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 2 | 23TEACZ2 | DISASTER MANAGEMENT | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 3 | 23TEACZ3 | VALUE EDUCATION | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 4 | 23TEACZ4 | CONSTITUTION OF INDIA | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 5 | 23TEACZ5 | PEDAGOGY STUDIES | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 6 | 23TEACZ6 | STRESS MANAGEMENT BY YOGA | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 7 | 23TEACZ7 | PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |
| 8 | 23TEACZ8 | SANSKRIT FORTECHNICAL KNOWLEDGE | AC | 40 | 60 | 100 | 2 | 0 | 0 | 0 |

## CURRICULUM DESIGN

| S.No | Course Work Subject Area | No of Credits | | | | | Percentage |
|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | Total | |
| 1. | Foundation Course | 7 | 0 | 0 | 0 | 07 | **10.00 %** |
| 2. | Professional Cores | 10 | 16 | 0 | 0 | 26 | **37.14%** |
| 3. | Employability Enhancement Courses | 0 | 2 | 8 | 12 | 22 | **31.43 %** |
| 4. | Professional Electives | 6 | 3 | 3 | 0 | 12 | **17.14 %** |
| 5. | Open Elective Courses | 0 | 0 | 3 | 0 | 03 | **4.29 %** |
| **Total Credits** | | **23** | **21** | **14** | **12** | **70** | **100.00%** |

| 23TEFCZ1 | RESEARCH METHODOLOGY AND IPR | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | FC | 3 | 0 | 0 | 3 |

| Course Objectives | 1.To impart knowledge on research methodology ,Quantitative methods for problem solving, data interpretation and report writing<br>2. To know the importance of IPR and patent rights. | |
|---|---|---|
| **UNIT – I** | **INTRODUCTION** | **9 Periods** |
| Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code. | | |
| **UNIT – II** | **QUANTITATIVE METHODS FOR PROBLEM SOLVING** | **9 Periods** |
| Statistical Modelling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis. | | |
| **UNIT – III** | **DATA DESCRIPTION AND REPORT WRITING** | **9 Periods** |
| Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis. Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing. | | |
| **UNIT – IV** | **INTELLECTUAL PROPERTY** | **9 Periods** |
| Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.<br>International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. | | |
| **UNIT – V** | **PATENT RIGHTS** | **9 Periods** |
| Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. | | |
| **Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total:45 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| 1 | *Stuart Melville and Wayne Goddard,* ***"Research methodology: an introduction for science & engineering students",*** *Juta Academic, 1996.* |
| 2 | *Donald H.McBurney and Theresa White,* ***"Research Methods",*** *9th Edition, engageLearning, 2013.* |
| 3 | *RanjitKumar,* ***"Research Methodology: A Step by Step Guide for Beginners",*** *5th Edition, 2014.* |
| 4 | *Dr. C. R. Kotharia and GauravGarg,* ***"Research Methodology: Methods and Trends",*** *New age international publishers, Fourth Edition, 2018.* |


| **COURSE OUTCOMES:**<br><br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Formulate research question for conducting research. | K4 |
| CO2 | Analyze qualitative and quantitative data. | K4 |
| CO3 | Interpret research findings and give appropriate conclusions. | K4 |
| CO4 | Develop a structured content to write technical report. | K4 |
| CO5 | Summarize the importance of IPR and protect their research work through intellectual property. | K4 |

| **Course Articulation Matrix** | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 1 | 2 | 1 | 1 | 2 |
| CO2 | 2 | - | - | - | - |
| CO3 | 3 | 3 | 3 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 2 |
| CO5 | 1 | 1 | 1 | 1 | 1 |
| **23TEFCZ1** | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| **ASSESSMENT PATTERN – THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 40 | 40 | 20 | - | - | - | 100 |
| CAT2 | 40 | 40 | 20 | - | - | - | 100 |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1 | - | 50 | 30 | 20 | - | - | 100 |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | - | 50 | 30 | 20 | - | - | 100 |
| ESE | 30 | 30 | 20 | 20 | - | - | 100 |

| 23TEFC02 | ADVANCED MATHEMATICS FOR THERMAL ENGINEERING | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | FC | 3 | 1 | 0 | 4 |

| Course Objective | The course is designed to teach students various techniques to solve linear, nonlinear equations including boundary value problems occur in engineering them to the important mathematical tool of numerical methods. | |
|---|---|---|
| **UNIT – I** | **SYSTEM OF LINEAR AND NONLINEAR EQUATIONS** | **9 +3 Periods** |
| System of linear equation: Gauss elimination method, Gauss Jordan method, Choleski method, Gauss Jacobi method, Gauss-Seidel method-System of nonlinear equations: Iteration method, Newton-Raphson method for single variable-Eigen value problems: Power method. | | |
| **UNIT – II** | **NUMERICAL DIFFERENTIATION AND INTEGRATION** | **9+3 Periods** |
| Interpolation: Newton's forward and backward interpolation, Newton's divided difference interpolation, Lagrange's Interpolation-Differentiation: Newton's Formula-Numerical integration: Trapezoidal rule, Simpson's 1/3rd and 3/8 rules-Gaussian two- and three-point quadrature formula. | | |
| **UNIT – III** | **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS** | **9+3 Periods** |
| First order differential equations: Taylor's series method-Euler and modified Euler's methods-Runge-Kutta method of fourth order- Milne's and Adam's predictor-corrector methods -Second order differential equations: Taylor's series method. | | |
| **UNIT – IV** | **NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS** | **9+3 Periods** |
| Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation- Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)-Finite difference explicit method for wave equation. | | |
| **UNIT – V** | **FINITE ELEMENT METHOD** | **9+3 Periods** |
| Basics of finite element method: Weak formulation, weighted residual method-Shape functions for linear and triangular element-Finite element method for two point boundary value problems, Laplace and Poisson equations. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| 1 | *S.S. Sastry,* ***Introductory methods of numerical analysis****, PHI, New Delhi, 5th Edition, 2015.* |
| 2 | *Ward Cheney, David Kincaid,* ***Numerical Methods and Computing,*** *Cengage Learning, Delhi, 7th Edition 2013.* |
| 3 | *James.G, "****Advanced Modern Engineering Mathematics"****, Pearson Education Asia, 4th edition, 2011.* |
| 4 | *Grewal.B.S.,* ***"Numerical Methods In Engineering And Science"****, Khanna Publishers New Delhi, 2014.* |
| 5 | *Veerarajan.Tand* Ramachandran.T, ***"Numerical Methods With Programming C"****, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2011.* |
| 6 | *S.R.K.Iyengar, R.K Jain,* ***"Numerical Methods"****, New Age International Publishers, New Delhi.* |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Solve the linear, non-linear equations and Eigenvalue problems using an appropriate numerical method. | K6 |
| CO2 | Gain the knowledge of numerical differentiation and integration. | K6 |
| CO3 | Construct one-step and linear multistep methods for the numerical solution of initial-value problems for ordinary differential equations and systems of such equations. | K6 |
| CO4 | Acquire the knowledge of principles for designing numerical schemes for PDEs in particular finite difference schemes, interpret solutions in a physical context of wave and heat equation in specified techniques. | K6 |
| C05 | Acquire the knowledge of principles for designing numerical schemes for PDEs in particular finite difference schemes, interpret solutions in a physical context of wave and heat equation in specified techniques. | K6 |

**Course Articulation Matrix**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | - | - | - | 1 |
| CO2 | 3 | 3 | - | - | - | 2 |
| CO3 | 3 | 3 | - | - | - | 2 |
| CO4 | 2 | 2 | - | - | - | 1 |
| CO5 | 1 | 2 | - | - | - | 1 |
| **23TEFC02** | 3 | 3 | - | - | - | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial

**ASSESSMENT PATTERN – THEORY**

| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
|---|---|---|---|---|---|---|---|
| CAT1 | 20 | 40 | 30 | 10 | - | - | 100 |
| CAT2 | 20 | 40 | 30 | 10 | - | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | - | 50 | 30 | 20 | - | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | - | 50 | 30 | 20 | - | - | 100 |
| ESE | 20 | 40 | 30 | 10 | - | - | 100 |

| 23TEPC01 | ADVANCED THERMODYNAMICS<br>*(Use of approved gas tables and charts are permitted)* | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| ENGINEERING THERMODYNAMICS | PC | 3 | 1 | 0 | 4 |

| Course Objective | To make the students learn the advanced concepts thermodynamic properties, multi phase systems, chemical and statistical thermodynamics, energy at micro level, conversion of heat energy in thermodynamic systems. | |
|---|---|---|
| **UNIT – I** | **AVAILABILITY AND THERMODYNAMIC PROPERTY RELATIONS** | **9+3 Periods** |
| Reversible work, Availability, Irreversibility and Second-Law Efficiency for a closed System and Steady-State Control Volume. Thermodynamic Potentials, Maxwell relations, Generalized relations for changes in Entropy, Internal Energy and Enthalpy, $C_p$ and $C_v$, Clausius Clayperon Equation, Joule-Thomson Coefficient, Bridgmann Tables for Thermodynamic relations. | | |
| **UNIT – II** | **SINGLE AND MULTI PHASE SYSTEMS** | **9+3 Periods** |
| SINGLE-PHASE SYSTEMS: Simple System, Equilibrium Conditions, The Fundamental Relations, Legendre Transforms, Relations between Thermodynamic Properties, EXERGY ANALYSIS: Non flow Systems, Flow Systems, Generalized Exergy Analysis, Air Conditioning and its types. MULTIPHASE SYSTEMS: The Energy Minimum Principle, The Stability of a Simple System, The Continuity of the Vapor and Liquid States, Phase Diagrams, Corresponding States. | | |
| **UNIT – III** | **REAL GAS AND MULTI-COMPONENT SYSTEMS** | **9+3 Periods** |
| Different Equations of State, Fugacity, Compressibility, Principle of Corresponding States, Use of generalized charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kessler generalized three parameter tables, Fundamental property relations for systems of variable composition, partial molar properties, Real gas mixtures, Ideal solution of real gases and liquids, Equilibrium in multi - phase systems, Gibbs phase rule for non-reactive components. | | |
| **UNIT – IV** | **CHEMICAL THERMODYNAMICS AND EQUILIBRIUM** | **9+3 Periods** |
| Thermo chemistry, First Law analysis of reacting systems, Adiabatic Flame temperature, Entropy change of reacting systems, Second Law analysis of reacting systems, Criterion for reaction equilibrium, Chemical availability, Equilibrium constant for gaseous mixtures, evaluation of equilibrium composition, Availability of reacting systems. | | |
| **UNIT – V** | **STATISTICAL THERMODYNAMICS** | **9+3 Periods** |
| Microstates and Macrostates, Thermodynamic probability, Degeneracy of energy levels, Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein Statistics, Microscopic Interpretation of heat and work, Evaluation of entropy, Calculation of the Macroscopic properties from partition functions, Equilibrium constant statistical thermodynamics approach. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods** | | |

**TEXT BOOK:**


| | |
|---|---|
| 1 | *Yunus Cengel, Michael Boles,* ***"Thermodynamics: An Engineering Approach",*** *9th Edition, 2019.* |
| 2 | *P.K.Nag,* ***"Engineering Thermodynamics"****, Tata McGraw Hill Education, 6 th Edition, 2017.* |

**REFERENCES:**


| | |
|---|---|
| 1 | *Kenneth Wark Jr., **"Advanced Thermodynamics for Engineers**, McGraw-Hill Inc. New York, 1995.* |
| 2 | *Holman, J.P., **"Thermodynamics"**, McGraw-Hill Inc, 4th Edition, 1988.* |
| 3 | *Smith, J.M. and Van Ness., H.C., **"Introduction to Chemical Engineering Thermodynamics"**, McGraw-Hill Inc., 4thEdition, 2005.* |
| 4 | *Bejan, A.,"Advanced**"Engineering Thermodynamics"**, John Wiley and Sons, 3rd edition, 2006.* |
| 5 | *Domkundwar, Kothandaraman, **"A Course in Thermal Engineering"**, DhanpatRai and Co, 2008.* |


| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Understand the thermodynamics property and relation between them. | K3 |
| CO2 | Understand the concepts of Thermodynamics Phase systems. | K5 |
| CO3 | Discuss the properties of different types of gases. | K2 |
| CO4 | Discuss the basic concepts of Irreversible and Chemical Thermodynamics. | K3 |
| CO5 | Derive equations and calculating the properties related to statistical thermodynamics. | K5 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 3 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 1 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| **23TEPC01** | 3 | 3 | 2 | 2 | 3 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **ASSESSMENT PATTERN – THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 30 | 30 | 10 | 10 | - | 100 |
| CAT2 | 30 | 30 | 20 | 10 | 10 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 20 | 10 | 10 | 30 | 30 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 20 | 30 | 20 | 20 | - | 100 |
| ESE | 30 | 20 | 15 | 20 | 15 | - | 100 |

| 23TEPC02 | **ADVANCED FLUID DYNAMICS**<br>*(use of approved gas tables and charts are permitted)* | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| FLUID MECHANICS AND HYDRAULIC MACHINERY | PC | 3 | 1 | 0 | 4 |

| Course Objective | To make the students learn the advanced concepts and equations of various types of fluid flows and realize the special effects due to turbulence, friction and shock. | |
|---|---|---|
| **UNIT – I** | **BASIC LAWS OF FLUID FLOW** | **9+3 Periods** |
| Condition for irrotationality, circulation and vorticity Accelerations in Cartesian systems normal and tangential accelerations, Euler's, Bernoulli equations in 3D– Continuity and Momentum Equations, Ideal and non-ideal flows, general equations of fluid motion, Navier - stokes equations and their exact solutions. Boundary layer theory, wedge flows, laminar flow over plates and through cylinders. | | |
| **UNIT – II** | **BOUNDARY LAYER THEORY** | **9+3 Periods** |
| Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory -Boundary layer thickness for flow over a flat plate – Von-Karman momentum integral equation -Blasius solution- Laminar boundary layer – Turbulent Boundary Layer – Expressions for local and mean drag coefficients for different velocity profiles. – Total Drag due to Laminar & Turbulent Layers –Problems. | | |
| **UNIT – III** | **TURBULENT FLOW** | **9+3 Periods** |
| Fundamental concept of turbulence – Time Averaged Equations –Boundary Layer Equations - Prandtl Mixing Length Model - Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k-ε model - boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders. | | |
| **UNIT – IV** | **SHOCK WAVE** | **9+3 Periods** |
| Normal and oblique shocks – Prandtl – Meyer expansion – Rankine Hugnoit relation. Application of method of characteristics applied to two-dimensional case – simple supersonic wind tunnel Design of supersonic wind tunnel and nozzle. | | |
| **UNIT – V** | **EXPERIMENTAL TECHNIQUES** | **9+3 Periods** |
| Role of experiments in fluid, layout of fluid flow experiments, sources of error in experiments, data analysis, design of experiments, review of probes and transducers, Introduction to Thermal Anemometry-Hot wire anemometer, Laser Doppler Velocimetry and Particle Image Velocimetry, Measurement of velocity components by 3 holes and 4 holes probes. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods** | | |

**TEXT BOOK:**


| | |
|---|---|
| 1 | *Mohanty, A. K., **"Fluid Mechanics"**, Prentice Hall of India, 2nd edition, 2006.* |
| 2 | *Yunus A Cengel, John M.Cimbala, **"Fluid Mechanics: Fundamentals and Applications"**, McGraw-Hill, 4th Edition, 2019* |

**REFERENCES:**


| | |
|---|---|
| 1 | *Muralidhar, K and Biswas, G.,* ***"Advanced Engineering Fluid Mechanics"****, Alpha Science International Ltd., 2015.* |
| 2 | *Pijush K. Kundu, Ira M Kohen and David R. Dawaling,* ***"Fluid Mechanics"****, Academic Press, 5th Edition 2011.* |
| 3 | *White, F. M.,* ***"Viscous Fluid Flow",*** *3rd Edition, Tata McGraw Hill Book Company, 2017.* |
| 4 | ***"Advanced Fluid Mechanics"*** *by Dr. Suman Chakraborty (IIT Kharagpur), NPTEL Course (Link: https://nptel.ac.in/courses/112/105/112105218/#)* |
| 5 | ***"Introduction to Turbulence"*** *by Prof. Gautam Biswas (IIT Kanpur), NPTEL Course (Link: https://nptel.ac.in/courses/112/104/112104120/)* |


| **COURSE OUTCOMES:** On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Understand fundamentals and Basic laws of Fluid Flows. | K3 |
| CO2 | Discuss the various laws pertaining to different Boundary layer concepts. | K5 |
| CO3 | Identify, formulate and solve problems related to fluid flows. | K5 |
| CO4 | Understand and Evaluate different wave phenomena. | K5 |
| CO5 | Apply fluid concepts in the experimental setups. | K5 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 3 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 1 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| **23TEPC02** | 3 | 3 | 2 | 2 | 3 | 2 |

| **ASSESSMENT PATTERN – THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 20 | 30 | 20 | 20 | 10 | - | 100 |
| CAT2 | 5 | 30 | 30 | 15 | 20 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 10 | 20 | 30 | 20 | 20 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 30 | 20 | 15 | 15 | 20 | - | 100 |
| ESE | 20 | 25 | 25 | 15 | 15 | - | 100 |

| 23TEPC03 | ADVANCED IC ENGINES AND SIMULATION LABORATORY | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | PC | 0 | 0 | 4 | 2 |

| Course Objective | To make the students learn the importance of various types of I.C engines and analyze them using commercial open source software. |
|---|---|

**LIST OF EXPERIMENTS** **(45)**

1. Performance test on Spark Ignition and Compression Ignition engines using Alternative fuels such as ethanol and Biofuels.
2. Performance test using pressure transducers in CI and SI Engines.
3. Performance and Heat balance test on I. C. Engines using a water dynamometer.
4. Performance test on variable compression ratio petrol and diesel engines.
5. Emission measurement in Spark Ignition and Compression Ignition Engines using smoke meter and gas analyzer.
6. Determination of Temperature Distribution using Thermal Imager.
7. Performance test on computerized Two Stage Air Compressor Test Rig.
8. Study on Drawing of Engine Components with Dimensions, Assembly and Disassembly.
9. Performance test on the effect of Air Fuel Ratio of the Two Stroke Single Cylinder Petrol Engine.
10. Study on Meshing Techniques and Turbulent Modeling.
11. Flow analysis over a Flat Plate for Boundary layer characteristics using CFD.
12. Convection Heat transfer analysis in laminar flow inside 2D pipe

**Contact Periods**:
**Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**

| COURSE OUTCOMES: On completion of the course, the students will be able to: | | Bloom's Taxonomy Mapped |
|---|---|---|
| CO1 | Evaluate the performance of SI and CI engines. | K5 |
| CO2 | Analyze the emission characteristics of IC engines. | K4 |
| CO3 | Study the various equipment used for analysis. | K4 |
| CO4 | Apply the principles of CFD in fluid flow problems. | K5 |
| CO5 | Learn the various tools used in analysis. | K3 |

**Course Articulation Matrix**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 3 | 2 | 1 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 1 | 3 | 3 |
| CO5 | 2 | 2 | 3 | 1 | 3 | 3 |
| **23TEPC03** | 2 | 3 | 3 | 1 | 2 | 2 |

| 23TEPE01 | THERMODYNAMICS AND COMBUSTION | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| ENGINEERING THERMODYNAMICS | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students learn advanced concepts like maximum energy and minimum energy, combustion principles, energy at micro level, conversion of heat energy into electrical flux of thermodynamic systems. | |
|---|---|---|
| **UNIT – I** | **BASIC CONCEPTS OF THERMODYNAMICS** | **9 Periods** |
| Entropy ,Work and Quantity of Heat: First Law of Thermodynamics ,Temperature ,Pressure, The Free Energy and the Thermodynamic Potentials , Enthalpy, Nernst's Theorem, Carnot's Cycle and Carnot's Theorem, Le Chatelier Principle, Dependence of the Thermodynamic Quantities on the Number of Particles, Ideal Gases ,Ideal Gases with Constant Specific Heat: Equation of Poisson Adiabatic. | | |
| **UNIT – II** | **IDEAL, REAL GASES AND VAPOUR MIXTURES** | **9 Periods** |
| Introduction, The Equation of State for a Perfect Gas, p-V-T Surface of an Ideal Gas,Internal Energy and Enthalpy of a Perfect Gas, Specific Heat Capacities of an Ideal Gas , Real Gases ,Vander Waal's Equation, Virial Equation of State, Beattie-Bridgeman Equation, Reduced Properties, Law of Corresponding States, Compressibility Chart,Dalton's Law and Gibbs-Dalton Law,Volumetric Analysis of a Gas Mixture, The Apparent Molecular Weight and Gas Constant ,Specific Heats of a Gas Mixture, Adiabatic Mixing of Perfect Gases ,Gas and Vapour Mixtures | | |
| **UNIT – III** | **FUNDAMENTALS OF COMBUSTION** | **9 Periods** |
| Thermodynamics, concepts of combustion – Combustion equations, heat of combustion Theoretical flame temperature, chemical equilibrium and dissociation, Combustion cycles. Stoichiometry, Theories of Combustion, Pre-flame reactions, Reaction rates, Rankine-Hugoniot relations – detonation branch-Analysis of the deflagration - Chapman- Jouguet waves, Laminar and Turbulent Flame propagation. | | |
| **UNIT – IV** | **FLAME PHENOMENA IN PREMIXED COMBUSTIBLE GASES** | **9 Periods** |
| Introduction , Laminar flame structure, The laminar flame speed , Stability limits of laminar flames, Flame propagation through stratified combustible mixtures, Turbulent reacting flows and turbulent flames, The turbulent flame speed, Stirred reactor theory ,Flame stabilization in high-velocity streams, Combustion in small volumes . | | |
| **UNIT – V** | **DETONATION AND ENVIRONMENTAL COMBUSTION CONSIDERATIONS** | **9 Periods** |
| Introduction, Detonation phenomena,Hugoniot relations and the hydrodynamic theory of detonations, Comparison of detonation velocity calculations with experimental results, The ZND structure of detonation waves, The structure of the cellular detonation front and other detonation phenomena parameters, The nature of photochemical smog, Formation and reduction of nitrogen oxides,SOx emissions . | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**


| | |
|---|---|
| 1 | *R.K Rajput,* ***"Engineering Thermodynamics",*** *Laxmi Publications Ltd, 6th edition,2016.* |
| 2 | *Irvin Glassman, Richard A. Yetter ,* ***"Combustion"****, Elsevier Inc., 5th edition,2014.* |

**REFERENCES:**


| | |
|---|---|
| 1 | *R. M. Helsdon,* ***"Introduction to Applied Thermodynamics"*** *, Elsevier Science, 2013.* |
| 2 | *Kenneth Wark Jr.,* ***"Advanced Thermodynamics for Engineers"****, McGraw-Hill Inc. New York, 1995.* |
| 3 | *Michael Liberman,* ***"Introduction to Physics and Chemistry of Combustion"****, Springer-Verlag Berlin Heidelberg, 2008.* |
| 4 | *Fawzy El-Mahallawy, Saad El-Din Habik,* **"*Fundamentals and technology of Combustion"*** *, Elsevier Science Ltd, 2002.* |


| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Understand the conceptsin thermodynamics and its relevant properties. | K3 |
| CO2 | Discuss the properties of various types of gases and vapour mixtures. | K4 |
| CO3 | Concept in combustion and its principles. | K5 |
| CO4 | Understand the concepts of flame phenomena during the combustion process. | K4 |
| C05 | Gain knowledge on environmental considerations of combustion. | K5 |

**Course Articulation Matrix**

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 1 |
| CO3 | 2 | 3 | 3 | 2 | 1 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 1 | 1 |
| CO5 | 2 | 3 | 3 | 2 | 1 | 2 |
| **23TEPE01** | 3 | 3 | 2 | 2 | 1 | 1 |

1 – Slight, 2 – Moderate, 3 – Substantial

**Assessment pattern – theory**

| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
|---|---|---|---|---|---|---|---|
| CAT1 | - | 30 | 35 | 35 | - | - | 100 |
| CAT2 | 10 | 25 | 25 | 20 | 20 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 135 | - | 30 | 35 | 35 | - | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 25 | 25 | 20 | 20 | - | 100 |
| ESE | 10 | 20 | 25 | 25 | 20 | - | 100 |

| 23TEPE02 | ARTIFICIAL INTELLIGENCE IN THERMAL SYSTEMS | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Course Objective** | To present a research oriented in depth knowledge of artificial intelligence and to address the underlying concepts, methods and application of artificial intelligence. | |
| **UNIT – I** | **INTRODUCTION** | **9 Periods** |
| Core of AI - Goals of AI - Fields of application - Global economic effects of artificial intelligence. | | |
| **UNIT – II** | **BASICS AND DRIVERS OF ARTIFICIAL INTELLIGENCE** | **9 Periods** |
| Moore's law and the effects of exponential- digitalization and dematerialization of products, services and processes-connecting products, services, processes, animals and people- Big data- new technologies. | | |
| **UNIT – III** | **ARTIFICIAL INTELLIGENCE IN HEAT TRANSFER ANALYSIS** | **9 Periods** |
| Application of New Artificial- Neural Network to Predict -Heat Transfer and Thermal Performance of heat exchangers. | | |
| **UNIT – IV** | **ARTIFICIAL INTELLIGENCE IN COMBUSTION STUDIES** | **9 Periods** |
| Artificial-intelligence- based prediction and control of combustion instabilities in spark-ignition engines and combustion - ignition engines. | | |
| **UNIT – V** | **ARTIFICIAL INTELLIGENCE IN THERMAL FLOW SIMULATION** | **9 Periods** |
| AI applications in thermal engineering – Artificial intelligence-based computational fluid dynamics approaches. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**


| | |
|---|---|
| 1 | *Adel Mellit, Soteris Kalogirou , **"Handbook of Artificial Intelligence Techniques in Photovoltaic Systems Modeling, Control, Optimization, Forecasting and Fault Diagnosis"**, Elsevier Science, 23 June 2022.* |
| 2 | *Ralf Herbrich, **"Learning Kernel classifiers theory and algorithm"**, MIT Press, Cambridge, London, England, 2022.* |

**REFERENCES:**


| | |
|---|---|
| 1 | *Ralf T. Kreutzer, Marie Sirrenberg,* ***"Understanding Artificial Intelligence Fundamentals, Use Cases and Methods for a Corporate AI Journey"****, Berlin, Germany Bad Wilsnack, Germany August 2019.* |
| 2 | *Amit Konar,* ***"Artificial Intelligence and Soft Computing Behavioral and Cognitive Modeling of the Human Brain" ,****CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, 8 October 2018.* |
| 3 | *Siddhartha Bhattacharyya, Vaclav Snasel,* ***"Hybrid Computational Intelligence challenges and applications A volume in hybrid computational intelligence for pattern analysis and understanding",*** *Springer, 2020. https://doi.org/10.1016/B978-0-12-818699-2.00009-3* |
| 4 | *Bryan Maldonado, Brian Kaul,* ***"Artificial Intelligence and Data Driven Optimization of Internal Combustion Engines",*** *Chapter 8, Springer, 2022. https://doi.org/10.1016/B978-0-323-88457-0.00006-0* |


| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Obtain the fundamental knowledge of AI basics. | K2 |
| CO2 | Gain the knowledge on machine learning techniques | K3 |
| CO3 | Understand the role of Artificial Intelligence in numerical studies. | K5 |
| CO4 | Gain knowledge for combustion studies by using Artificial Intelligence | K3 |
| CO5 | Analyse the thermal flow simulations using Artificial Intelligence | K5 |

| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | 2 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 2 | 2 |
| **23TEPE02** | 3 | 2 | 3 | 3 | 3 | 2 |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 30 | 35 | 35 | - | - | - | 100 |
| CAT2 | 10 | 30 | 30 | - | 30 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 30 | 35 | 35 | - | - | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 30 | 30 | - | 30 | - | 100 |
| ESE | 15 | 25 | 20 | 20 | 20 | - | 100 |

| 23TEPE03 | ADVANCED GAS TURBINES<br>*(Use of approved tables and charts are permitted)* | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| THERMAL ENGINEERING | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students learn aircraft applications of power plant cycles and turbo machines like compressors, axial and radial flow turbines and combustors. | |
|---|---|---|
| **UNIT – I** | **INTRODUCTION** | **9 Periods** |
| Power plant cycles for stationery and aircraft applications, component behaviors, Industrial applications, Marine and land transportation, Environmental issues, analysis of ramjet, turbojet and turbo-propeller, Inlets and nozzles. | | |
| **UNIT – II** | **COMPRESSORS** | **9 Periods** |
| Principle and operations of Centrifugal and axial flow compressors momentum and energy transfer in rotors, velocity diagrams, calculation of stage performance, compressibility effects, cascade testing and characteristics. | | |
| **UNIT – III** | **AXIAL AND RADIAL FLOW TURBINE** | **9 Periods** |
| Elementary theory of axial and radial flow turbine, Vortex theorem, choice of blade profile, Pitch and Chord Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, materials, testing and performance characteristics. | | |
| **UNIT – IV** | **COMBUSTORS** | **9 Periods** |
| Different types and flow patterns, material requirements and cooling systems, air pollution and reduction. | | |
| **UNIT – V** | **MATCHING** | **9 Periods** |
| Matching procedure of power plant components, engine off-design performance,Off-design performance of single shaft gas turbine, free turbine engine and jet engine, Methods of displacing the equilibrium running line, Design of Nozzles, afterburners, anti-icing mechanisms. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**

| | |
|---|---|
| 1 | *Dixon S.L., **"Fluid Mechanics and Thermodynamics of Turbomachinery"**, Pergamon Press, 7th edition 2013.* |
| 2 | *Ganesan V., **"Gas Turbines"**, Tata McGraw Hill, 3rd Edition, 2017.* |

**REFERENCES:**


| | |
|---|---|
| 1 | *Yahya S.M., **"Turbines, Compressors and Fans"**, Tata mcgraw-Hill, 4th edition, 2017.* |
| 2 | *Sarvanamuttoo, H.I.H., Rogers, G. F. C. and Cohen, **"Gas Turbine Theory"**, H., Pearson Prentice Hall, 7th Edition, 2019.* |
| 3 | *Kerrebrock J.L., **"Aircraft engines and gas turbines"**, The MIT Press, 2nd edition, 1992.* |
| 4 | *Gurrappa Injeti, **"Gas Turbines"**, IntechOpen, ISBN-978-953-51-1743-8, February 25th2015.* |


| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Identify, formulate and solve problems related to gas turbines and jet propulsion. | K5 |
| CO2 | Analyze the operational aspects and control, including the system interaction of compressors | K5 |
| CO3 | Discuss the various laws pertaining to different fluid flow applications | K2 |
| CO4 | Learn the components of a combustor and its performance. | K2 |
| CO5 | Knowledge on matching the components. | K5 |

**Course Articulation Matrix**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 2 | 3 | 2 | 1 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 |
| **23TEPE03** | 3 | 3 | 2 | 2 | 3 | 2 |

**Assessment pattern – theory**

| Test / Bloom's Category* | Remembering (k1) % | Understanding (k2) % | Applying (k3) % | Analyzing (k4) % | Evaluating (k5) % | Creating (k6) % | Total % |
|---|---|---|---|---|---|---|---|
| CAT1 | 15 | 25 | 20 | 20 | 20 | - | 100 |
| CAT2 | 10 | 90 | - | - | - | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 15 | 25 | 20 | 20 | 20 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 90 | - | - | - | - | 100 |
| ESE | 10 | 30 | 20 | 20 | 20 | - | 100 |

| 23TEPE04 | DESIGN OF CONDENSERS, EVAPORATORS AND COOLING TOWERS | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students learn the heat transfer processes and design of heat transfer equipment. | |
|---|---|---|
| **UNIT – I** | **INTRODUCTION** | **9 Periods** |
| Principles of heat transfer, Types of heat exchangers, Standard Representation, Parts description, TEMA classifications, Applications. | | |
| **UNIT – II** | **CONDENSERS** | **9 Periods** |
| Estimation of heat transfer coefficient, Fouling factor, Friction factor- Design procedures, Wilson plots, Design different types of condensers, BIS Standards. | | |
| **UNIT – III** | **EVAPORATORS** | **9 Periods** |
| Different types of evaporators, Design procedure, Factors affecting the evaporator capacity, Thermal Stress calculations, matching of components, Design of evaporative condensers. | | |
| **UNIT – IV** | **COOLING TOWERS** | **9 Periods** |
| Types of Cooling towers, Analytical and graphical design procedures, Tower Characteristics Parametric analysis, Range of cooling tower, Tower efficiency, cooling tower load, Energy conservation. | | |
| **UNIT – V** | **SELECTION OF CONDENSERS, EVAPORATORS AND COOLING TOWER** | **9 Periods** |
| Condenser selection – Water cooled – Air cooled, Selection of evaporators, Selection of cooling tower, Selection of Pumps and Fans. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**

| | |
|---|---|
| 1 | *Lieke Wang, Bengt Sunden, Raj M. Manglik, **"Plate Heat Exchangers: Design, Applications and Performance"**, WIT Press, 2013.* |
| 2 | *Krishna P. Singh, Alan I. Soler, **"Mechanical Design of Heat Exchangers And Pressure Vessel Components",** Springer Berlin Heidelberg, 4 December 2014.* |

**REFERENCES:**

| | |
|---|---|
| 1 | *Manfred Nitsche, Raji Gbadamosi., **"Design of Heat exchangers, condensers and evaporators"**, 2015.* |
| 2 | *Kern K.H., **"Process heat transfer"**, McGraw-Hill, 2nd edition, 2017.* |
| 3 | *Wilfried Roetzel, Xing Luo, Dezhen Chen, **"Design and Operation of Heat Exchangers and Their Networks"**, Elsevier Science, 4 October 2019.* |
| 4 | *S Chand, R S Khurmi, J K Gupta, **"Modern Refrigeration and Air Conditioning"**, published, 2019.* |

| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Utilize the principles of heat transfer for industrial applications. | K2 |
| CO2 | Design the condenser, evaporators and cooling towers. | K2 |
| CO3 | Understand the concepts of evaporators. | K3 |
| CO4 | Gain the knowledge of cooling towers, Analytical and graphical design procedures | K3 |
| CO5 | Select the suitable heat transfer equipment | K3 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 1 | 1 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 1 | 2 | 2 |
| CO5 | 2 | 2 | 1 | 2 | 1 | 2 |
| **23TEPE04** | 2 | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 50 | 50 | - | - | - | - | 100 |
| CAT2 | 25 | 35 | 40 | - | - | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 50 | 50 | - | - | - | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 25 | 35 | 40 | - | - | - | 100 |
| ESE | 25 | 25 | 50 | - | - | - | 100 |

| 23TEPE05 | INSTRUMENTATION IN THERMAL ENGINEERING | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Course Objective** | To learn different techniques involved in thermal quantity measurement and the concept of microprocessors in measurement, different kind of errors involved and the transducers for different types of thermo-physical quantities | |
| **UNIT – I** | **MEASUREMENT CHARACTERISTICS** | **9 Periods** |
| Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments. | | |
| **UNIT – II** | **MICROPROCESSORS AND COMPUTERS IN MEASUREMENT** | **9 Periods** |
| Basic Electrical measurements, Transducers and its types, Signal conditioning and processing- Measurement of temperature, pressure, velocity, flow – basic and advanced techniques, and radiation properties of surfaces. | | |
| **UNIT – III** | **MEASUREMENT OF PHYSICAL QUANTITIES** | **9 Periods** |
| Thermo, Physical, Chemical and transport properties of solids, liquids and gaseous fuels, Analyses – Flame Ionization Detector, Non-Dispersive Infrared Analyses, Chemiluminescence detector, Smoke meters, and Gas chromatography. | | |
| **UNIT – IV** | **CONTROL SYSTEM, COMPONENTS AND CONTROLLERS** | **9 Periods** |
| Introduction, Open and closed loop control systems, Transfer function. Types of feedback and feedback control system characteristics – Control system parameters – DC and AC servomotors, servo amplifier, potentiometer, synchronic transmitters, synchronic receivers, synchronic control transformer, stepper motors - Continuous, Discontinuous and Composite control modes – Analog and Digital controllers. | | |
| **UNIT – V** | **DESIGN OF MEASUREMENT AND CONTROL SYSTEMS** | **9 Periods** |
| Data logging and acquisition - Sensors for error reduction, elements of computer interfacing, Timers, and Counters, Designing of measurement and control systems for specific applications - Fault finding – Computer based controls | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**

| | |
|---|---|
| 1 | *Holman, J.P., **"Experimental methods for engineers"**, McGraw-Hill, 8th edition 2011.* |
| 2 | *Rangan, C.S., Sharma, GR., Mani, V.S.V, **"Instrumentation Devices and Systems"**, Tata McGraw Hill, 2nd edition, New Delhi, 2017.* |

**REFERENCES:**

| | |
|---|---|
| 1 | *Alan S. Morris, Reza Langari**, "Measurement and Instrumentation"**, Elsevier Science, 2015* |
| 2 | *Barney, **"Intelligent Instrumentation"**, Prentice Hall of India, 2012.* |
| 3 | *Preobrazhensky, V., **"Measurements and Instrumentation in Heat Engineering"**, Vol.1 and 2, MIR Publishers, 2013.* |
| 4 | *Doeblin, **"Measurement System Application and Design"**, McGraw Hill, 2012.* |
| 5 | *Morris.A.S, **"Principles of Measurements and Instrumentation",** Prentice Hall of India, 2006.* |

| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Gain the knowledge on various measuring instruments and advance measurement techniques. | K2 |
| CO2 | Evaluate the various steps involved in error analysis and uncertainty analysis. | K5 |
| CO3 | Analyze the various thermal and flow systems and their behaviour. | K5 |
| CO4 | Distinguish between measurement and control systems, and use appropriate control<br>System for an application. | K2 |
| CO5 | Construct a complete control system for a thermal application. | K2 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 2 | 2 | 2 | 1 | 1 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO5 | 1 | 1 | 2 | 1 | 2 | 1 |
| **23TEPE05** | 2 | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 10 | 30 | 30 | - | 30 | - | 100 |
| CAT2 | 10 | 20 | 20 | 20 | 30 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 10 | 30 | 30 | - | 30 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 20 | 20 | 20 | 30 | - | 100 |
| ESE | 10 | 20 | 30 | 30 | 10 | - | 100 |

| 23TEPE06 | ENGINE ELECTRONICS | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| APPLIED ELECTRONICS | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students learn concepts of Automotive Electronics and its evolution and trends of sensor monitoring mechanisms to design and model various automotive ignition and injection systems control for different vehicles. | |
|---|---|---|
| **UNIT – I** | **SENSORS** | **9 Periods** |
| Types – Air flow, Pressure, Temperature, Speed Oxygen, Detonation, Position –Principle of Operation, Arrangement and material. | | |
| **UNIT – II** | **GASOLINE INJECTION SYSTEM** | **9 Periods** |
| Open loop and closed loop systems, Mono point, Multi point and direct injection systems –Principles and Features, Bosch injection systems. | | |
| **UNIT – III** | **DIESEL INJECTION SYSTEM** | **9 Periods** |
| Inline injection pump, Rotary pump and injector – Construction and principle of operation, Common rail and unit injector system – Construction and principle of operation. | | |
| **UNIT – IV** | **IGNITION SYSTEMS** | **9 Periods** |
| Ignition fundamentals, Types of solid -state ignition systems, high energy ignition distributors, Electronic spark timing and control. | | |
| **UNIT – V** | **ENGINE MAPPING** | **9 Periods** |
| Combined ignition and fuel management systems. Digital control techniques – Dwell angle calculation, Ignition timing calculation and Injection duration calculation, Hybrid vehicles and fuel cells. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**

| | |
|---|---|
| 1 | *Tom Denton, **"Automotive Electrical and Electronic Systems"**, Edward Amold, 5th edition 2017.* |
| 2 | *Robert N.Brady, **"Automotive Computers and Digital Instrumentation"**, Prentice Hall, 2011.* |

**REFERENCES:**

| | |
|---|---|
| 1 | *Ali Emadi, **"Handbook of Automotive Power Electronics and Motor Drives"**, CRC Press, 19 December 2017.* |
| 2 | *Konrad Reif, **"Fundamentals of Automotive and Engine Technology Standard Drives, Hybrid Drives, Brakes, Safety Systems"**, Springer Fachmedien Wiesbaden, 16 June 2014.* |
| 3 | *Akhilendra Pratap Singh, Avinash Kumar Agarwal, **"Novel Internal Combustion Engine Technologies for Performance Improvement and Emission Reduction"**, Springer Nature Singapore, 14 June 2021.* |
| 4 | *Heinz Heisler., **"Advanced Engine Technology"**, SAE Publications, 2011.* |
| 5 | *Ronald K. Jurgan, **"Electronic Engine Control"**, Edward Amold, 2017.* |

| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Obtain an overview on the types of sensors. | K2 |
| CO2 | Understand the various injection systems and its principal of operation. | K2 |
| CO3 | Develop the knowledge on ignition and fuel management systems. | K4 |
| CO4 | Gain the knowledge of Ignition fundamentals, types of solid, electronic sparking timing and control. | K3 |
| CO5 | Utilize the dwell angle calculation, Ignition timing calculation for engine mapping in hybrid vehicles and fuel cells. | K5 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 2 | 2 | 2 | 2 | 1 | 2 |
| CO2 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 1 |
| CO4 | 1 | 1 | 2 | 1 | 1 | 1 |
| CO5 | 2 | 2 | 1 | 2 | 2 | 1 |
| **23TEPE06** | 2 | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 10 | 30 | 30 | - | 30 | - | 100 |
| CAT2 | 10 | 20 | 20 | 20 | 30 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 10 | 30 | 30 | - | 30 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 20 | 20 | 20 | 30 | - | 100 |
| ESE | 10 | 20 | 30 | 30 | 10 | - | 100 |

| 23TEPE07 | FINITE ELEMENT METHODS IN THERMAL ENGINEERING | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| HEAT AND MASS TRANSFER | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students learn different discretization methods for solving heat transfer and fluid flow problems. | |
|---|---|---|
| **UNIT – I** | **INTRODUCTION** | **5 Periods** |
| Overview of numerical methods - Discretized representation of physical systems - thermal resistance – Governing equations and Boundary conditions for thermal and flow systems. | | |
| **UNIT – II** | **ONE DIMENSIONAL HEAT CONDUCTION** | **6 Periods** |
| Principles of variations calculus - applications of variational approach to one dimensional heat conduction – element matrix contribution and assembly. | | |
| **UNIT – III** | **HEAT FUNCTIONS AND ANALYSIS** | **10 Periods** |
| Weighted residual methods - Galerkin's approach - Shape functions. Application of Galerkin's weighted residual approach to one dimensional heat conduction - Three noded triangular elements- 1-D steady state conduction using triangular elements - Radiation and natural convective boundary conditions – incorporation of variations in thermal properties. | | |
| **UNIT – IV** | **CONVECTIVE HEAT TRANSFER** | **12 Periods** |
| Higher order elements and numerical integration solution of heat conduction and creeping flow using higher order element - Solution of convective heat transfer. | | |
| **UNIT – V** | **HEAT EXCHANGER APPLICATIONS** | **12 Periods** |
| Incompressible laminar flow simulation - Stream function and Vorticity methods, Velocity Pressure formulation, mixed order interpolation for incompressible flow modifications for turbulent flow. Application to heat exchanger. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**


| | |
|---|---|
| 1 | *S.S.Rao, **"The Finite Element Method in Engineering"**, Pergamon Press, 5th edition, 2013.* |
| 2 | *Larry Segerlind **"Applied Finite Element Analysis"**, John Wiley & Sons, 2nd edition, 2005.* |


**REFERENCES:**


| | |
|---|---|
| 1 | *C.S.Krishnamoorthy, **"Finite Element Analysis Theory and Programming",** Tata McGraw-Hill, 2nd edition, 2011.* |
| 2 | *J.N.Reddy, **"An Introduction to Finite Elements Methods"**, McGraw-Hill, 2020.* |
| 3 | *O.C.Zienkiewiez, **"Finite Element Methods",** McGraw-Hill, 2003.* |
| 4 | *T.R.Chandrapatla and Belegundu, **"Introduction to Finite Elements in Engineering"**, Prentice Hall of India, 2002.* |

| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Understand the basic numerical methods and governing equations of heat transfer and fluid flow conditions. | K3 |
| CO2 | Evaluate temperature distribution in one and two-dimensional conduction and convection problems numerically. | K5 |
| CO3 | Analyze the various flow problems to evaluate the performance of heat exchangers. | K5 |
| CO4 | Apply higher order elements and numerical integration solutions of heat conduction and convective heat transfer. | K5 |
| CO5 | Analyze the laminar and turbulent flow problems to evaluate the performance of heat exchangers | K5 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 1 | 1 | 2 | 2 | 2 | 2 |
| CO2 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 1 | 1 |
| **23TEPE07** | 2 | 1 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 10 | 30 | 30 | - | 30 | - | 100 |
| CAT2 | - | 25 | 25 | 30 | 20 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 10 | 30 | 30 | - | 30 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | - | 25 | 25 | 30 | 20 | - | 100 |
| ESE | 10 | 25 | 25 | 20 | 20 | - | 100 |

| 23TEPE08 | **ADVANCED GAS DYNAMICS AND SPACE PROPULSION**<br>*(Use of approved tables and charts are permitted)* | **I** |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| GAS DYNAMICS AND JET PROPULSION | PE | 3 | 0 | 0 | 3 |

| | | |
|---|---|---|
| **Course Objective** | To make the students learn the compressible flow through different systems and propulsion systems for jet and space vehicles. | |
| **UNIT – I** | **BASIC CONCEPTS AND ISENTROPIC FLOWS** | **9 Periods** |
| Energy and momentum equations of compressible fluid flows – isentropic flow - Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables. | | |
| **UNIT – II** | **FLOW THROUGH DUCTS** | **9 Periods** |
| The Shock Tube: Propagating Expansion Fan - Flows through constant area ducts with heat transfer and Friction - variation of flow properties Use of tables and charts - Unsteady Shock Waves: The Shock Tube - Applications, Method of Characteristics: Flow through a diverging channel. | | |
| **UNIT – III** | **NORMAL AND OBLIQUE SHOCKS** | **9 Periods** |
| Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks- Supersonic Flow over a Wavy wall - Finite Wave Theory: An introduction to the Method of Characteristics. Prandtl – Meyer expansion and relation. Supersonic Flow past a HD Cone at an angle of attack - Bluff Body at an angle of attack - Flow Visualization-Use of table and charts. | | |
| **UNIT – IV** | **JET PROPULSION** | **9 Periods** |
| Theory of jet propulsion – thrust equation – thrust power and propulsive efficiency. Operation, cycle analysis and performance of ramjet, turbojet, turbofan and turboprop engines. | | |
| **UNIT – V** | **SPACE PROPULSION** | **9 Periods** |
| Types of rocket engines and propellants. Characteristic velocity, Theory of single and multistage rocket propulsion, Liquid fuel feeding systems, Solid propellant geometries. Space flights – orbital and escape velocity, Rocket performance calculations – nuclear and electrical rocket propulsion. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**


| | |
|---|---|
| 1 | *S.M. Yahya, **"Fundamentals of Compressible Flow with Aircraft and Rocket propulsion"**, New Age International (P) Limited, 6th edition, 2018.* |
| 2 | *Radhakrishnan, E., **"Gas Dynamics"**, Prentice Hall of India, 7th edition, 2020.* |

**REFERENCES:**


| | |
|---|---|
| 1 | *H. Saravanamutto HIH, Cohen H., Rogers CEC&Straznicky PV,* ***"Gas Turbine Theory"****,Printice Hall, 7th edition, 2019.* |
| 2 | *L. Anderson, J.D.,* ***"Modern Compressible Flow"****, McGraw Hill, 3rdedition, 2017.* |
| 3 | *Sutton, G.P.,* ***"Rocket Propulsion Elements"****, John wiley, New York,9th edition, 2017.* |
| 4 | *Shapiro,* ***"Dynamics and Thermodynamics of Compressible Fluid Flow"****, Prentice hall of India, 7th edition, 2014.* |


| **COURSE OUTCOMES:** On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Understand the basic concepts of various flows. | K2 |
| CO2 | Analyze the application using ducts. | K5 |
| CO3 | Basic theorems derive to normal and oblique shocks. | K2 |
| CO4 | Know the concepts of various jet engines. | K5 |
| CO5 | Design and application of rocket science and engineering. | K3 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 2 | 2 | 1 | 1 | 1 | 2 |
| CO2 | 2 | 2 | 1 | 1 | 1 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO5 | 2 | 2 | 2 | 1 | 2 | 2 |
| **23TEPE08** | 2 | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 15 | 35 | 50 | - | - | - | 100 |
| CAT2 | 10 | 25 | 25 | 20 | 20 | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 15 | 35 | 50 | - | - | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | 10 | 25 | 25 | 20 | 20 | - | 100 |
| ESE | 10 | 25 | 25 | 30 | 10 | - | 100 |

| 23TEPE09 | STEAM ENGINEERING | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students learn various power generation units, steam generators, heat balance and safety standards of various steam generating units. | |
|---|---|---|
| **UNIT – I** | **INTRODUCTION** | **9 Periods** |
| Parameter of a steam Generator – Thermal calculations of Modern steam Generator – Tube Metal Temperature Calculation and choice of Materials – Steam purity Calculations and Water treatment. | | |
| **UNIT – II** | **STEAM SYSTEM AND HEAT BALANCE** | **9 Periods** |
| Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system- Heat transfer in Furnace – Furnace Heat Balance –Calculation of Heating Surfaces – Features of Firing systems for solid – Liquid and Gaseous Fuels – Design of Burners. | | |
| **UNIT – III** | **BOILER DESIGN** | **9 Periods** |
| Design of Boiler Drum – Steam Generator Configurations for Industrial Power and Recovery Boiler – Pressure Loss and Circulation in Boilers. | | |
| **UNIT – IV** | **DESIGN OF ACCESSORIES** | **9 Periods** |
| Design of Air Preheaters – Economizer and Superheater for high pressure Steam Generators – Design Features of Fuel Firing Systems and Ash Removing Systems. | | |
| **UNIT – V** | **BOILER CODE** | **9 Periods** |
| IBR and International Regulations – ISI Code's Testing and Inspection of Steam Generator – Safety Methods in Boilers – Factor of safety in the Design of Boiler Drum and Pressure parts-Safety of Fuel Storage and Handling – Safety Methods of Automatic Operation of Steam Boilers. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**

| | |
|---|---|
| 1 | *P.K. Nag, **"Power Plant Engineering"**, McGraw Hill Education, 4th edition 2017.* |
| 2 | *Domkundwar, **"A Course in Power Plant Engineering"**, Dhanapat Rai & Co, 2016.* |

**REFERENCES:**

| | |
|---|---|
| 1 | *Kumar Rayaprolu, **"Boilers"**, A Practical Reference, CRC Press, 2012.* |
| | *Kayla Westra, Larry Drbal, Lawrence F. Drbal, Pat Boston, **"Power Plant Engineering",** Springer US,2012.* |
| 3 | *Kumar Rayaprolu , **"Boilers for Power and Process",** CRC Press, 2009.* |
| 4 | *Richard Dolezal, **"Large Boiler Furnaces"** Elsevier Company, 2008.* |

| **COURSE OUTCOMES:**<br><br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Learn the parameters and calculations of steam generators. | K5 |
| CO2 | Understand the steam systems and heat balance in steam generators. | K2 |
| CO3 | Gain the knowledge in various designs of boilers. | K4 |
| CO4 | Design the accessories of a steam generator. | K4 |
| CO5 | Understand the codes and standards. | K5 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 3 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 3 | 2 |
| CO5 | 2 | 2 | 3 | 1 | 2 | 2 |
| **23TEPE09** | 2 | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | 15 | 20 | - | 35 | 30 | - | 100 |
| CAT2 | - | 35 | 35 | 30 | - | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 15 | 20 | - | 35 | 30 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | - | 35 | 35 | 30 | - | - | 100 |
| ESE | 10 | 35 | 30 | 15 | 10 | - | 100 |

| 23TEPE10 | SUPERCHARGING AND SCAVENGING | I |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | PE | 3 | 0 | 0 | 3 |

| Course Objective | To make the students to learn effects of supercharging and scavenging in I.C engines and design of exhaust systems | |
|---|---|---|
| **UNIT – I** | **SUPERCHARGING** | **8 Periods** |
| Objectives - Effects on engine performance – engine modification required - Thermodynamics of Mechanical supercharging and Turbocharging - Turbo charging methods - Engine exhaust manifolds arrangements. | | |
| **UNIT – II** | **COMPRESSORS** | **10 Periods** |
| Types of compressors – Positive displacement blowers - Centrifugal compressors - Performance characteristic curves- Suitability for engine application - Surging - Matching of supercharger compressor and Engine – Matching of compressor, Turbine Engine. | | |
| **UNIT – III** | **SCAVENGING OF TWO STROKE ENGINES** | **12 Periods** |
| Peculiarities of two stroke cycle engines - Classification of scavenging systems - Mixture control through Reed valve induction - Charging Processes in two stroke cycle engine - Terminologies - Shankey diagram – Relation between scavenging terms - scavenging modeling - perfect displacement, Perfect mixing Complex scavenging models. | | |
| **UNIT – IV** | **PORTS AND MUFFLER DESIGN** | **8 Periods** |
| Porting - Design considerations - Design of intake and Exhaust Systems - Tuning. | | |
| **UNIT – V** | **EXPERIMENTAL METHODS** | **7 Periods** |
| Experimental techniques for evaluating scavenging - Firing engine tests - Non firing engine tests – Port flow characteristics - Kadenacy system - Orbital engine combustion system, Sonic system. | | |
| **Contact Periods**:<br>**Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods** | | |

**TEXT BOOK:**

| | |
|---|---|
| 1 | *Obert, E.F., **"Internal Combustion Engines and Air Pollution",** McGraw-Hill, 2017.* |
| 2 | *Vincent,E.T., **"Supercharging the I.C.Engines",** Facsimile publishers, 2015.* |

**REFERENCES:**

| | |
|---|---|
| 1 | *Giancarlo Ferrari, Angelo Onorati, Gianluca D'Errico, **"Internal Combustion Engines"**, Società Editrice Esculapio, 21 July 2022.* |
| 2 | *K.A. Zinner, **"Supercharging of Internal Combustion Engines"**, 4 July 2012.* |
| 3 | *Evangelos G Giakoumis, **"Turbochargers and Turbocharging Advancements, Applications and Research"** Nova Science Publishers, Incorporated, 2017.* |
| 4 | *JohnB. Heywood, **"Two-Stroke Cycle Engine its Development, Operation and Design"**, CRC Press, November 2017.* |
| 5 | *Schweitzer, P.H., **"Scavenging of Two Stroke Cycle Diesel Engine"**, MacMillan Co.2007.* |
| 6 | *John B.Heywood, **"Two Stroke Cycle Engine"**, SAE Publications 2010.* |

| **COURSE OUTCOMES:**<br>On completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Design and make thermal analysis of the supercharging system and scavenging processes. | K4 |
| CO2 | Design and tune intake and exhaust systems to achieve desired performance results. | K5 |
| CO3 | Address specific issues arising in laboratory testing of modified engines. | K3 |
| CO4 | Develop and design of ports and muffler design consideration | K3 |
| CO5 | Evaluate the characteristics involved in non-firing engine tests using experimental techniques. | K5 |

| **Course Articulation Matrix** | | | | | | |
|---|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
| CO1 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 1 | 3 | 2 |
| CO3 | 2 | 2 | 2 | 1 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 1 | 2 |
| CO5 | 3 | 3 | 2 | 1 | 1 | 2 |
| **23TEPE10** | 2 | 2 | 2 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | | |

| **Assessment pattern – theory** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (k1) %** | **Understanding (k2) %** | **Applying (k3) %** | **Analyzing (k4) %** | **Evaluating (k5) %** | **Creating (k6) %** | **Total %** |
| CAT1 | - | 30 | 30 | 20 | 20 | - | 100 |
| CAT2 | - | 50 | 50 | - | - | - | 100 |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | - | 30 | 30 | 20 | 20 | - | 100 |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | - | 50 | 50 | - | - | - | 100 |
| ESE | - | 25 | 25 | 25 | 25 | - | 100 |

| 23TEACZ1 | ENGLISH FOR RESEARCH PAPER WRITING<br>*(Common to all branches)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| | | |
|---|---|---|
| **Course Objective** | 1.To make the learners understand the need for writing good research paper<br>2.To expose them to know the intricacies involved in word order, sentence structure and paragraph writing<br>3.To make learners practice unambiguous writing<br>4.To train the learners avoid wordiness in writing<br>5.To make learners understand the elements involved in writing journal paper. | |
| **UNIT – I** | **PLANNING AND PREPARATION** | **6 Periods** |
| Need for publishing articles, Choosing the journal, Identifying a model journal paper, Creation of files for each section, Expectations of Referees, Online Resources. | | |
| **UNIT – II** | **SENTENCES AND PARAGRAPHS** | **6 Periods** |
| Basic word in English, Word order in English and Vernacular, placing nouns, Verbs, Adjectives, and Adverb suitably in a sentence, Using Short Sentences, Discourse Markers and Punctuations- Structure of a Paragraph, Breaking up lengthy Paragraphs. | | |
| **UNIT – III** | **ACCURACY, BREVITY AND CLARITY (ABC) OF WRITING** | **6 Periods** |
| Accuracy, Brevity and Clarity in Writing, Reducing the linking words, Avoiding redundancy, Appropriate use of Relative and Reflexive Pronouns, Monologophobia, verifying the journal style, Logical Connections between others author's findings and yours. | | |
| **UNIT – IV** | **HIGHLIGHTING FINDINGS, HEDGING AND PARAPHRASING** | **6 Periods** |
| Making your findings stand out, Using bullet points headings, Tables and Graphs- Availing non-experts opinions, Hedging, Toning Down Verbs, Adjectives, Not over hedging, Limitations of your research. | | |
| **UNIT – V** | **SECTIONS OF A PAPER** | **6 Periods** |
| Titles, Abstracts, Introduction, Review of Literature, Methods, Results, Discussion, Conclusions, References. | | |
| **Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total:30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| *1* | Goldbort R , "Writing for Science", Yale University Press (available on GoogleBooks),2006 |
| *2* | Day R , How to Write and Publish a Scientific Paper, Cambridge University Press, 2006. |
| *3* | Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book, 1998. |
| *4* | Adrian Wallwork," English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011. |


| **COURSE OUTCOMES:**<br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | **U**nderstand the need for writing good research paper. | K4 |
| CO2 | Practice the appropriate word order, sentence structure and paragraph writing. | K4 |
| CO3 | Practice unambiguous writing. | K4 |
| CO4 | Avoid wordiness in writing. | K4 |
| CO5 | Exercise the elements involved in writing journal paper. | K4 |

| Course Articulation Matrix | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 2 | 1 | 2 | 2 | 1 |
| CO2 | 2 | 2 | 1 | 1 | 1 |
| CO3 | 2 | 1 | 1 | 1 | 1 |
| CO4 | 2 | 2 | 1 | 1 | 1 |
| CO5 | 1 | 2 | 1 | 1 | 1 |
| **23TEACZ1** | 2 | 2 | 1 | 1 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| **ASSESSMENT PATTERN – THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 40 | 40 | 20 | - | - | - | 100 |
| CAT2 | 40 | 40 | 20 | - | - | - | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | - | 50 | 50 | - | - | - | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | - | 50 | 50 | - | - | - | 100 |
| ESE | 30 | 30 | 40 | - | - | - | 100 |

| 23TEACZ2 | DISASTER MANAGEMENT<br>*(Common to all branches)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| | | |
|---|---|---|
| **Course Objectives** | 1. To become familiar in key concepts and consequences about hazards, disaster and area of occurrence.<br>2. To know the various steps in disaster planning.<br>3. To create awareness on disaster preparedness and management. | |
| **UNIT – I** | **INTRODUCTION** | **6 Periods** |
| Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. Areas proneto ,EarthquakesFloods ,Droughts, Landslides , Avalanches ,Cyclone and Coastal Hazards with Special Reference to Tsunami. | | |
| **UNIT – II** | **REPERCUSSIONS OF DISASTERS AND HAZARDS** | **6 Periods** |
| Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts. | | |
| **UNIT – III** | **DISASTER PLANNING** | **6 Periods** |
| Disaster Planning-Disaster Response Personnel roles and duties, Community MitigationGoals, Pre-Disaster Mitigation Plan, Personnel Training, Comprehensive Emergency Management, Early Warning Systems. | | |
| **UNIT – IV** | **DISASTER PREPAREDNESS AND MANAGEMENT** | **6 Periods** |
| Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness. | | |
| **UNIT – V** | **RISK ASSESSMENT** | **6 Periods** |
| Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival. | | |
| **Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| 1 | *R. Nishith, Singh AK, **"Disaster Management In India: Perspectives, Issues And Strategies"**, New Royal book Company, 2007.* |
| 2 | *Sahni, PardeepEt.Al. (Eds.), **"Disaster Mitigation Experiences And Reflections"**, Prentice Hall Of India, New Delhi, 2010* |
| 3 | *Goel S. L, **"Disaster Administration And Management Text And Case Studies"**, Deep &Deep Publication Pvt. Ltd., New Delhi, 2008.* |
| 4 | *Jagbir Singh, **"Disaster Management: Future Challenges And Opportunities"**, I.K. International Publishing House Pvt. Ltd., New Delhi, 2007.* |
| 5 | *Damon Coppola **"Introduction To International Disaster Management"**, Butterworth-Heinemann, 2015* |
| 6 | *Ryan Lanclos **"Dealing With Disasters: Gis For Emergency Management"**,ESRI Press 2021.* |

| **COURSE OUTCOMES:**<br><br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Differentiate hazard and disaster with their significance. | K4 |
| CO2 | Analyze the causes and impact of natural and manmade disaster. | K4 |
| CO3 | Execute the steps involved in disaster planning. | K4 |
| CO4 | Predict vulnerability of disaster and to prevent, mitigate their impact. | K4 |
| CO5 | Prepare risk assessment strategy for national and global disaster. | K4 |

| **Course Articulation Matrix** | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 2 | 1 | 1 | 2 | 2 |
| CO2 | 1 | 2 | 1 | 1 | 1 |
| CO3 | 1 | 1 | 1 | 2 | 2 |
| CO4 | 1 | 1 | 1 | 2 | 2 |
| CO5 | 2 | 1 | 1 | 2 | 2 |
| **23TEACZ2** | 1 | 1 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| **ASSESSMENT PATTERN – THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | 50 | 50 | | | | | 100 |
| CAT2 | | | 100 | | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | 50 | 50 | | | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | | 100 | | | | 100 |
| ESE | 25 | 25 | 50 | | | | 100 |

| 23TEACZ3 | VALUE EDUCATION<br>*(Common to all branches)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| Course Objectives | 1. Value of education and self- development.<br>2. Requirements of good values in students.<br>3. Importance of character. | |
|---|---|---|
| **UNIT – I** | **ETHICS AND SELF-DEVELOPMENT** | **6 Periods** |
| Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements. | | |
| **UNIT – II** | **PERSONALITY AND BEHAVIOR DEVELOPMENT** | **6 Periods** |
| Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. | | |
| **UNIT – III** | **VALUES IN HUMAN LIFE** | **6 Periods** |
| Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature,Discipline. | | |
| **UNIT – IV** | **VALUES IN SOCIETY** | **6 Periods** |
| True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature. | | |
| **UNIT – V** | **POSITIVE VALUES** | **6 Periods** |
| Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively. | | |
| **Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| 1 | *Chakroborty, S.K.* ***"Values and Ethics for organizations Theory and practice"****, Oxford University Press, New Delhi,1998* |
| 2 | *Dr.Yogesh Kumar Singh,* ***"Value Education"****, A.P.H Publishing Corporation,New Delhi,2010* |
| 3 | *R.P Shukla,* ***"Value Education and Human Rights"****, Sarup and Sons, NewDelhi,2004* |
| 4 | *https://nptel.ac.in/courses/109104068/36* |


| COURSE OUTCOMES:<br><br>Upon completion of the course, the students will be able to: | | Bloom's Taxonomy Mapped |
|---|---|---|
| CO1 | Know the values and work ethics. | K3 |
| CO2 | Enhance personality and behaviour development. | K3 |
| CO3 | Apply the values in human life. | K3 |
| CO4 | Gain Knowledge of values in society. | K3 |
| CO5 | Know the importance of positive values in human life. | K3 |

| Course Articulation Matrix | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 1 | 2 | 1 | 1 | 2 |
| CO3 | 1 | 2 | 1 | 2 | 2 |
| CO4 | 1 | 1 | 1 | 2 | 2 |
| CO5 | 1 | 1 | 2 | 2 | 2 |
| **23TEACZ3** | 1 | 1 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| ASSESSMENT PATTERN – THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | | | 100 | | | | 100 |
| CAT2 | | | 100 | | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | | | 100 | | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | | 100 | | | | 100 |
| ESE | | | 100 | | | | 100 |

| 23TEACZ4 | CONSTITUTION OF INDIA<br>*(Common to all branches.)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| | | |
|---|---|---|
| **Course Objectives** | 1. To address the importance of constitutional rights and duties<br>2. To familiarize about Indian governance and local administration.<br>3. To know about the functions of election commission. | |
| **UNIT – I** | **INDIAN CONSTITUTION** | **6 Periods** |
| History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features. | | |
| **UNIT – II** | **CONSTITUTIONAL RIGHTS & DUTIES** | **6 Periods** |
| Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. | | |
| **UNIT – III** | **ORGANS OF GOVERNANCE** | **6 Periods** |
| Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions. | | |
| **UNIT – IV** | **LOCAL ADMINISTRATION** | **6 Periods** |
| Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. | | |
| **UNIT – V** | **ELECTION COMMISSION** | **6 Periods** |
| Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women. | | |
| **Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| *1* | ***"The Constitution of India"**, 1950 (Bare Act), Government Publication.* |
| *2* | *Dr. S. N. Busi, Dr. B. R. Ambedkar**"Framing of Indian Constitution",** 1st Edition, 2015.* |
| *3* | *M. P. Jain, **"Indian Constitution Law",** 7th Edn., Lexis Nexis, 2014.* |
| *4* | *D.D. Basu, **"Introduction to the Constitution of India",** Lexis Nexis, 2015.* |


| COURSE OUTCOMES:<br>Upon completion of the course, the students will be able to: | | Bloom's Taxonomy Mapped |
|---|---|---|
| CO1 | Discuss the growth of the demand for civil rights in India. | K2 |
| CO2 | Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. | K2 |
| CO3 | Know the various organs of Indian governance. | K2 |
| CO4 | Familiarize with the various levels of local administration. | K2 |
| CO5 | Gain knowledge on election commission of India. | K2 |

| Course Articulation Matrix | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 1 | 1 | 2 | 1 | 2 |
| CO3 | 1 | 2 | 1 | 1 | 2 |
| CO4 | 1 | 1 | 1 | 2 | 2 |
| CO5 | 1 | 1 | 1 | 2 | 2 |
| **23TEACZ4** | 1 | 1 | 1 | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| ASSESSMENT PATTERN – THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | | 100 | | | | | 100 |
| CAT2 | | 100 | | | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | | 100 | | | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | 100 | | | | | 100 |
| ESE | | 100 | | | | | 100 |

| 23TEACZ5 | PEDAGOGY STUDIES<br>*(Common to all branches)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| | | |
|---|---|---|
| **Course Objectives** | 1. To Understand of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.<br>2. Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology. | |
| **UNIT – I** | **INTRODUCTION** | **6 Periods** |
| Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching. | | |
| **UNIT – II** | **PEDAGOGICAL PRACTICES** | **6 Periods** |
| Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. | | |
| **UNIT – III** | **PEDAGOGICAL APPROACHES** | **6 Periods** |
| How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teacher's attitudes and beliefs and Pedagogic strategies. | | |
| **UNIT – IV** | **PROFESSIONAL DEVELOPMENT** | **6 Periods** |
| Professional development: alignment with classroom practices and follow-up support. Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes. | | |
| **UNIT – V** | **CURRICULUM AND ASSESSMENT** | **6 Periods** |
| Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact. | | |
| **Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| 1 | *Ackers J, Hardman F ,**Classroom interaction in Kenyan primary schools,Compare**, 31 (2): 245-261, 2001.* |
| 2 | *Alexander RJ ,**Culture and pedagogy: International comparisons in primary education**. Oxford and Boston: Blackwell, 2001* |
| 3 | *Akyeampong K, Lussier K, Pryor J, Westbrook J,**Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?** International Journal Educational Development, 33 (3): 272–282, 2013.* |
| 4 | *Agrawal M ,**Curricular reform in schools: The importance of evaluation**, Journal of Curriculum Studies, 36 (3): 361-379, 2004* |

| **COURSE OUTCOMES:**<br><br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Explain the concept of curriculum, formal and informal education systems and teacher education. | K3 |
| CO2 | Explain the present pedagogical practices and the changes occurring in pedagogical approaches | K3 |
| CO3 | Know the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class. | K3 |
| CO4 | Perform research in design a problem in pedagogy and curriculum development. | K3 |

| **Course Articulation Matrix** | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | 1 | 2 | 1 | 2 | 2 |
| CO2 | 1 | 1 | 2 | 1 | 1 |
| CO3 | 1 | 2 | 1 | 1 | 1 |
| CO4 | 1 | 2 | 1 | 1 | 1 |
| **23TEACZ5** | 1 | 2 | 1 | 1 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| **ASSESSMENT PATTERN – THEORY** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | | | 100 | | | | 100 |
| CAT2 | | | 100 | | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | | | 100 | | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | | 100 | | | | 100 |
| ESE | | | 100 | | | | 100 |

| 23TEACZ6 | **STRESS MANAGEMENT BY YOGA**<br>*(Common to all branches)* | **SEMESTER** |
|---|---|---|

| **PREREQUISITES** | **CATEGORY** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| **NIL** | **AC** | **2** | **0** | **0** | **0** |

| **Course Objectives** | 1. To create awareness on the benefits of yoga and meditation.<br>2. To understand the significance of Asana and Pranayama. | |
|---|---|---|
| **UNIT – I** | **PHYSICAL STRUCTURE AND ITS FUNCTIONS** | **6 Periods** |
| Yoga - Physical structure, Importance of physical exercise, Rules and regulation of simplified physical exercises, hand exercise, leg exercise, breathing exercise, eye exercise, kapalapathy, maharasana, body massage, acupressure, body relaxation. | | |
| **UNIT – II** | **YOGA TERMINOLGIES** | **6 Periods** |
| Yamas - Ahimsa, satya, astheya, bramhacharya, aparigrahaNiyamas- Saucha, santosha, tapas, svadhyaya, Ishvarapranidhana. | | |
| **UNIT – III** | **ASANA** | **6 Periods** |
| Asana - Rules & Regulations – Types & Benefits | | |
| **UNIT – IV** | **PRANAYAMA** | **6 Periods** |
| Regularization of breathing techniques and its effects-Types of pranayama | | |
| **UNIT – V** | **MIND** | **6 Periods** |
| Bio magnetism& mind - imprinting & magnifying – eight essential factors of living beings, Mental frequency and ten stages of mind, benefits of meditation, such as perspicacity, magnanimity, receptivity, adaptability, creativity. | | |
| **Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| 1 | *Janardan Swami Yogabhyasi Mandal,* ***"Yogic Asanas for Group Tarining-Part-I"****, Nagpur.* |
| 2 | *Swami Vivekananda, "****Rajayoga or conquering the Internal Nature"****, AdvaitaAshrama (Publication Department), Kolkata.* |
| 3 | *PanditShambuNath,* ***"Speaking of Stress Management Through Yoga and Meditation"****,New Dawn Press, New Delhi, 2016.* |
| 4 | *K. N. Udupa,* ***"Stress and its management by Yoga"****, MotilalBanarsidassPublishers,New Delhi, 2007.* |


| **COURSE OUTCOMES:**<br><br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Practice physical exercises and maintain good health. | K3 |
| CO2 | Attain knowledge on the various concepts of Yoga. | K3 |
| CO3 | Perform various Asanas with an understanding on their benefits. | K3 |
| CO4 | Practice breathing techniques in a precise manner. | K3 |
| CO5 | Attain emotional stability and higher level of consciousness. | K3 |

| Course Articulation Matrix | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | - | - | - | 2 | 2 |
| CO2 | - | - | - | 2 | 1 |
| CO3 | - | - | - | 1 | 2 |
| CO4 | - | - | - | 2 | 1 |
| CO5 | - | - | - | 1 | 2 |
| **23TEACZ6** | - | - | - | 2 | 2 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| ASSESSMENT PATTERN – THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | | 50 | 50 | | | | 100 |
| CAT2 | | | 100 | | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | | 50 | 50 | | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | | 100 | | | | 100 |
| ESE | | 50 | 50 | | | | 100 |

| 23TEACZ7 | PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS<br>*(Common to all branches)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| Course Objectives | 1. To familiar with Techniques to achieve the highest goal in life.<br>2. To become a person with stable mind, pleasing personality and determination. | |
|---|---|---|
| **UNIT – I** | | **6 Periods** |
| Neetisatakam-Holistic development of personality-Verses- 19,20,21,22 (wisdom)-Verses29,31,32 (pride & heroism)-Verses- 26,28,6. | | |
| **UNIT – II** | | **6 Periods** |
| Verses- 52,53,59 (dont's)-Verses- 71,73,75,78 (do's). - Approach to day to day work and duties.- Shrimad BhagwadGeeta - Chapter 2-Verses 41, 47,48, | | |
| **UNIT – III** | | **6 Periods** |
| Shrimad BhagwadGeeta -Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,- Chapter 18-Verses 45, 46, 48. | | |
| **UNIT – IV** | | **6 Periods** |
| Statements of basic knowledge.-Shrimad BhagwadGeeta: -Chapter2-Verses 56, 62, 68 -Chapter 12 -Verses 13, 14, 15, 16,17, 18-Personality of Role model. | | |
| **UNIT – V** | | **6 Periods** |
| Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39-Chapter18 – Verses 37,38,63. | | |
| | | |
| **Lecture:30 Periods** | **Tutorial: 0 Periods** **Practical: 0Periods** | **Total: 30 Periods** |

**REFERENCES:**


| | |
|---|---|
| 1 | *Swami SwarupanandaAdvaita Ashram* ***"Srimad Bhagavad Gita"****, AdvaitaAshrama , Kolkata,2016* |
| 2 | *P.Gopinath, Rashtriya Sanskrit Sansthanam* ***"Bhartrihari's Three Satakam"*** *(Niti-sringar-vairagya), New Delhi, 1986.* |
| 3 | *Swami Mukundananda, JagadguruKripalujiYog* ***"Bhagavad Gita: The Song Of God"****, USA,2019* |
| 4 | *A.C. Bhaktivedanta Swami Prabhupada* ***"Bhagavad-Gita As It Is"****,Bhaktivedanta Book Trust Publications,2001.* |


| **COURSE OUTCOMES:**<br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Apply the Holistic development in life. | K4 |
| CO2 | Effective Planning of day to day work and duties. | K4 |
| CO3 | Identify mankind to peace and prosperity. | K4 |
| CO4 | Develop versatile personality. | K4 |

| **Course Articulation Matrix** | | | | | |
|---|---|---|---|---|---|
| **COs/POs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** |
| CO1 | - | - | - | 1 | 1 |
| CO2 | - | - | - | 2 | 1 |
| CO3 | - | - | - | 1 | 1 |
| CO4 | - | - | - | 2 | 1 |
| **23TEACZ7** | - | - | - | 2 | 1 |
| 1 – Slight, 2 – Moderate, 3 – Substantial | | | | | |

| ASSESSMENT PATTERN – THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | | | | 100 | | | 100 |
| CAT2 | | | | 100 | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | | | | 100 | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | | | 100 | | | 100 |
| ESE | | | | 100 | | | 100 |

| 23TEACZ8 | SANSKRIT FOR TECHNICAL KNOWLEDGE<br>*(Common to all branches)* | SEMESTER |
|---|---|---|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---|---|---|---|---|---|
| NIL | AC | 2 | 0 | 0 | 0 |

| Course Objectives | 1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world.<br>2. Learning of Sanskrit to improve brain functioning.<br>3. Enhancing the memory power.<br>4. Learning of Sanskrit to develop the logic in mathematics, science & other subjects. | |
|---|---|---|
| **UNIT – I** | **BASICS OF SANSKRIT** | **6 Periods** |
| Alphabets in Sanskrit, Past/Present/Future Tense. | | |
| **UNIT – II** | **SENTENCES AND ROOTS** | **6 Periods** |
| Simple Sentences - Order, Introduction of roots. | | |
| **UNIT – III** | **SANSKRIT LITERATURE** | **6 Periods** |
| Technical information about Sanskrit Literature | | |
| **UNIT – IV** | **TECHNICAL CONCEPTS -1** | **6 Periods** |
| Technical concepts of Engineering-Electrical, Mechanical | | |
| **UNIT – V** | **TECHNICAL CONCEPTS -2** | **6 Periods** |
| Technical concepts of Engineering-Architecture, Mathematics | | |
| **Lecture:30 Periods Tutorial: 0 Periods Practical: 0Periods Total: 30 Periods** | | |

**REFERENCES:**


| | |
|---|---|
| *1* | Dr.Vishwas, "**Abhyaspustakam",** Samskrita-Bharti Publication, New Delhi, 2020. |
| *2* | Prathama DeekshaVempatiKutumbshastri, "**Teach Yourself Sanskrit**", Rashtriya Sanskrit Sansthanam, New Delhi, Publication, 2009. |
| *3* | Suresh Soni, **"India's Glorious Scientific Tradition**", Ocean books (P) Ltd., New Delhi,2006. |


| **COURSE OUTCOMES:**<br><br>Upon completion of the course, the students will be able to: | | **Bloom's Taxonomy Mapped** |
|---|---|---|
| CO1 | Recognize ancient literature and their basics | K3 |
| CO2 | Formulate the sentences with order and understand the roots of Sanskrit | K3 |
| CO3 | Acquire familiarity of the major traditions of literatures written in Sanskrit | K3 |
| CO4 | Distinguish the Technical concepts of Electrical & Mechanical Engineering | K3 |
| CO5 | Categorize the Technical concepts of Architecture & Mathematics | K3 |

**Course Articulation Matrix**

| COs/POs | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | 1 | 2 | 1 | 2 | 2 |
| CO2 | 1 | 2 | - | 1 | 2 |
| CO3 | 1 | 1 | 1 | 1 | 2 |
| CO4 | 2 | 1 | 1 | 1 | 1 |
| CO5 | 1 | 2 | 1 | 1 | 1 |
| **23TEACZ8** | 1 | 2 | 1 | 1 | 2 |

1 – Slight, 2 – Moderate, 3 – Substantial

| ASSESSMENT PATTERN – THEORY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test / Bloom's Category*** | **Remembering (K1) %** | **Understanding (K2) %** | **Applying (K3) %** | **Analyzing (K4) %** | **Evaluating (K5) %** | **Creating (K6) %** | **Total %** |
| CAT1 | | 50 | 50 | | | | 100 |
| CAT2 | | 50 | 50 | | | | 100 |
| Individual Assessment 1/Case Study 1/Seminar 1/Project 1 | | 50 | 50 | | | | 100 |
| Individual Assessment 2/Case Study 2/Seminar 2/Project 2 | | 50 | 50 | | | | 100 |
| ESE | | 50 | 50 | | | | 100 |