**ANNA UNIVERSITY, CHENNAI**

**NON- AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY**
**M.E. INTERNAL COMBUSTION ENGINEERING**
**REGULATIONS 2021**
**CHOICE BASED CREDIT SYSTEM**
**I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABUS**
**SEMESTER I**

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | MA4154 | Advanced Numerical Methods | FC | 4 | 0 | 0 | 4 | 4 |
| 2. | IC4151 | Alternate Fuels for IC Engines | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | IC4101 | Combustion in Engines | PCC | 3 | 0 | 0 | 3 | 3 |
| 4. | TE4151 | Advanced Heat Transfer | FC | 4 | 0 | 0 | 4 | 4 |
| 5. | TE4152 | Advanced Thermodynamics | PCC | 3 | 1 | 0 | 4 | 4 |
| 6. | RM4151 | Research Methodology and IPR | RMC | 2 | 0 | 0 | 2 | 2 |
| 7. | | Professional Elective - I | PEC | 3 | 0 | 0 | 3 | 3 |
| 8. | | Audit Course – I* | AC | 2 | 0 | 0 | 2 | 0 |
| **PRACTICAL** | | | | | | | | |
| 9. | IC4111 | Internal Combustion Engines Laboratory | PCC | 0 | 0 | 4 | 4 | 2 |
| | | | **TOTAL** | **24** | **1** | **4** | **29** | **25** |



**SEMESTER II**

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | IC4252 | Electronic Engine Management Systems | PCC | 3 | 0 | 0 | 3 | 3 |
| 2. | IC4201 | Internal Combustion Engine Design | PCC | 3 | 0 | 0 | 3 | 3 |
| 3. | IC4251 | Computational Fluid Dynamics | PCC | 3 | 0 | 0 | 3 | 3 |
| 4. | IC4202 | Instrumentation for Thermal Systems | PCC | 3 | 0 | 0 | 3 | 3 |
| 5. | | Professional Elective - II | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | | Professional Elective - III | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | | Audit Course - II* | AC | 2 | 0 | 0 | 2 | 0 |
| **PRACTICAL** | | | | | | | | |
| 8. | IC4211 | Analysis and Simulation Laboratory for Internal Combustion Engineering | PCC | 0 | 0 | 4 | 4 | 2 |
| 9. | IC4212 | Mini project with seminar | EEC | 0 | 0 | 2 | 2 | 1 |
| | | | **TOTAL** | **20** | **0** | **6** | **26** | **21** |

## SEMESTER III

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **THEORY** | | | | | | | | |
| 1. | | Professional Elective - IV | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | | Professional Elective - V | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | | Open Elective | OEC | 3 | 0 | 0 | 3 | 3 |
| **PRACTICAL** | | | | | | | | |
| 4. | IC4311 | Project Work - I | EEC | 0 | 0 | 12 | 12 | 6 |
| | | | **TOTAL** | **9** | **0** | **12** | **21** | **15** |

## SEMESTER IV

| SL. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PERWEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| **PRACTICAL** | | | | | | | | |
| 1. | IC4411 | Project Work - II | EEC | 0 | 0 | 24 | 24 | 12 |
| | | | **TOTAL** | **0** | **0** | **24** | **24** | **12** |



**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE: 73**

## PROFESSIONAL ELECTIVES

### SEMESTER I, ELECTIVE I

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IC4001 | Automotive Technology | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | IC4002 | Advanced Fluids Engineering | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | IC4003 | Simulation of I.C. Engine Processes | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | IC4004 | Fuels and Lubricants | PEC | 3 | 0 | 0 | 3 | 3 |

### SEMESTER II, ELECTIVE II

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IC4005 | Aircraft and Space Propulsion | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | EY4072 | Bio Energy Technologies | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | IC4072 | Engine Pollution and Control | PEC | 3 | 0 | 0 | 3 | 3 |



### SEMESTER II, ELECTIVE III

| SL. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IC4073 | Hybrid and Electric Vehicles | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | IC4006 | Combustion and Reaction Kinetics in I.C. Engines | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | EY4074 | Energy Forecasting, Modeling and Project Management | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | TE4073 | Hydrogen and Fuel Cell Technologies | PEC | 3 | 0 | 0 | 3 | 3 |

**SEMESTER III, ELECTIVE IV**

| SL. NO. | COURSE CODE | COURSETITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IC4071 | Boundary Layer Theory and Turbulence | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | IC4007 | Advanced Combustion Concepts in Engines | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | IC4008 | Manufacturing and Testing of Engine Components | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | IC4009 | Specialty Engines | PEC | 3 | 0 | 0 | 3 | 3 |

**SEMESTER III, ELECTIVE V**

| SL. NO. | COURSE CODE | COURSETITLE | CATE GORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | IC4010 | Supercharging and Turbocharging | PEC | 3 | 0 | 0 | 3 | 3 |
| 2. | EY4071 | Advanced Energy Storage Technologies | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | IC4011 | Electrical Drives and Controls | PEC | 3 | 0 | 0 | 3 | 3 |



**AUDIT COURSES (AC)**

**Registration for any of these courses is optional to students**

| SL. NO | COURSE CODE | COURSE TITLE | PERIODS PER WEEK | | | CREDITS |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1. | AX4091 | English for Research Paper Writing | 2 | 0 | 0 | 0 |
| 2. | AX4092 | Disaster Management | 2 | 0 | 0 | 0 |
| 3. | AX4093 | Constitution of India | 2 | 0 | 0 | 0 |
| 4. | AX4094 | நற்றமிழ் இலக்கியம் | 2 | 0 | 0 | 0 |

**MA4154** **ADVANCED NUMERICAL METHODS** **L T P C**
**4 0 0 4**

**COURSE OBJECTIVES :**

- To study various numerical techniques to solve linear and non-linear algebraic and transcendental equations.
- To compare ordinary differential equations by finite difference and collocation methods.
- To establish finite difference methods to solve Parabolic and hyperbolic equations.
- To establish finite difference method to solve elliptic partial differential equations.
- To provide basic knowledge in finite elements method in solving partial differential equations.

**UNIT I ALGEBRAIC EQUATIONS 12**

Systems of linear equations : Gauss elimination method – Pivoting techniques – Thomas algorithm for tri diagonal system – Jacobi, Gauss Seidel, SOR iteration methods – Conditions for convergence - Systems of nonlinear equations : Fixed point iterations, Newton's method, Eigenvalue problems : Power method and Given's method.

**UNIT II ORDINARY DIFFERENTIAL EQUATIONS 12**

Runge - Kutta methods for system of IVPs – Numerical stability of Runge - Kutta method – Adams - Bashforth multistep method, Shooting method, BVP: Finite difference method, Collocation method and orthogonal collocation method.

**UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS 12**

Parabolic equations : Explicit and implicit finite difference methods – Weighted average approximation - Dirichlet's and Neumann conditions – Two dimensional parabolic equations – ADI method : First order hyperbolic equations – Method of numerical integration along characteristics – Wave equation : Explicit scheme – Stability.



**UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS 12**

Laplace and Poisson's equations in a rectangular region : Five point finite difference schemes, Leibmann's iterative methods, Dirichlet's and Neumann conditions – Laplace equation in polar coordinates : Finite difference schemes – Approximation of derivatives near a curved boundary while using a square mesh.

**UNIT V FINITE ELEMENT METHOD 12**

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.

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Solve an algebraic or transcendental equation, linear system of equations and differential equations using an appropriate numerical method.
- Solving the initial boundary value problems and boundary value problems using finite difference and finite element methods.
- Solving parabolic and hyperbolic partial differential equations by finite difference methods.
- Compute solution of elliptic partial differential equations by finite difference methods.
- Selection of appropriate numerical methods to solve various types of problems in engineering and science in consideration with the minimum number of mathematical operations involved, accuracy requirements and available computational resources.

**REFERENCES :**
1. Burden, R.L., and Faires, J.D., "Numerical Analysis – Theory and Applications", 9th Edition, Cengage Learning, New Delhi, 2016.
2. Gupta S.K., "Numerical Methods for Engineers",4th Edition, New Age Publishers, 2019.
3. Jain M. K., Iyengar S. R., Kanchi M. B., Jain, "Computational Methods for Partial Differential Equations", New Age Publishers ,1993.
4. Sastry, S.S., "Introductory Methods of Numerical Analysis", 5th Edition, PHI Learning, 2015.
5. Saumyen Guha and Rajesh Srivastava, "Numerical methods for Engineering and Science", Oxford Higher Education, New Delhi, 2010.
6. Smith, G. D., "Numerical Solutions of Partial Differential Equations: Finite Difference Methods", Clarendon Press, 1985.

| IC4151 | ALTERNATE FUELS FOR IC ENGINES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1 To expose potential alternate fuels and their characteristics
2 To use appropriate synthetic fuels and fuel additives for better combustion characteristics
3 To utilise alcohol fuels effectively for lower emissions
4 To elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines
5 To utilise different gaseous fuels and predict their performance and combustion characteristics



**UNIT I INTRODUCTION 9**

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Alcohols, Biodiesel, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Biogas, Fuel standards – ASTM & EN.

**UNIT II SPECIAL AND SYNTHETIC FUELS 9**

Different synthetic fuels, Merits, and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexi-fuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

**UNIT III ALCOHOL FUELS 9**

Alcohols – Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Issues & limitation in alcohols

**UNIT IV BIO-DIESEL FUELS 9**

Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating, Transesterification and emulsification – Performance, combustion and emission characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines

**UNIT V GASEOUS FUELS 9**

Biogas, Natural gas, LPG, Hydrogen – Properties, problems, storage and safety aspects. Methods of utilisation in engines. Performance, combustion and emission characteristics in engines. Issues & limitation in Gaseous fuels

**TOTAL:45 PERIODS**

**COURSE OUTCOMES :**

The students will be able to

1 expose potential alternate fuels and their characteristics
2 use appropriate synthetic fuels and fuel additives for better combustion characteristics
3 utilise alcohol fuels effectively for lower emissions
4 elaborate on the utilisation of Bio-Diesel and its types as a suitable fuel in CI engines
5 utilise different gaseous fuels and predict their performance and combustion characteristics

**REFERENCES:**

1. Keith Owen and Trevor Eoley, Automotive Fuels Handbook, SAE Publications, 1990.
2. PundirB.P, I.C. Engines Combustion and Emission, 2010, Narosa Publishing House.
3. Pundir B.P , Engine Combustion and Emission, 2011, Narosa Publishing House Keith
4. Richard L. Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997

**IC4101 COMBUSTION IN ENGINES L T P C**
**3 0 0 3**

**COURSE OBJECTIVES**

1. To make familiar with the design and operating characteristics of engines
2. To understand the basic principles of combustion
3. To gain knowledge in the principles of SI engine combustion
4. To understand the concepts of CI engine system
5. To understand the basic concepts of gas turbine combustion and the latest technological advances in low temperature combustion

**UNIT I ENGINE BASICS 9**

Principles of Engine operation – Torque and Power Characteristics – Intake and Exhaust Flows – Fuel Characteristics – ISO standards (Qualitative treatment only) Balancing, valve trains



**UNIT II COMBUSTION PRINCIPLES 9**

Combustion – Combustion equations, chemical equilibrium and Dissociation -Theories of Combustion - Flammability Limits - Reaction rates - Laminar and Turbulent Flame Propagation in Engines, Flame structure and speed - Chemical kinetics.

**UNIT III COMBUSTION IN S.I. ENGINES 9**

Stages of combustion, Cylinder pressure measurement and heat release analysis normal and abnormal combustion, knocking, Variables affecting Knock, Features and design consideration of combustion chambers, Types of combustion chambers., Cyclic variations, Lean burn combustion, Stratified charge combustion systems. Heat release correlations.

**UNIT IV COMBUSTION IN C.I. ENGINES 9**

Stages of combustion, and spray formation and characterization, air motion, swirl measurement, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion, Direct and indirect injection systems.

**UNIT V COMBUSTION IN GAS TURBINES & LOW TEMPERATURE COMBUSTION CONCEPTS IN I.C. ENGINE 9**

Requirements - Combustion process – combustion chamber configurations – Flame stabilization – Design consideration of combustor – Factors affecting combustor performance – Emission and its control, Afterburners. Homogeneous charge compression ignition (HCCI) engine – Premixed charge compression ignition (PCCI) engine, Gasoline Direct Injection Compression Ignition (GDCI) engine, Reactivity controlled compression ignition (RCCI) engine – An introduction.

**TOTAL:45 CREDITS**

**COURSE OUTCOMES**

1. Given an engine design specification, predict performance and fuel economy trends
2. Apply basic concepts in the design of combustion systems
3. Able to design SI engine system
4. Develop an understanding of real world diesel engine design issues
5. Develop an ability to optimize future engine design for better fuel economy, performance, and emissions

**REFERENCES**


1. Ganesan, V, Internal Combustion Engines, Tata McGraw Hill Book Co., 2003.
2. John B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill Book, 1998.
3. Pundir B P, I.C. Engines Combustion and Emission, 2010, Narosa Publishing House.
4. Rajput R.K. Internal Combustion Engines, Laxmi Publications (P) Ltd, 2006.
5. Cohen, H, Rogers, G, E.C, and Saravanamuttoo, H.I.H., Gas Turbine Theory, Longman Group Ltd., 1980.


**TE4151 ADVANCED HEAT TRANSFER L T P C**
**4 0 0 4**

**COURSE OBJECTIVES**

- To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.
- To analyse the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges**.**
- To achieve an understanding of the basic concepts of phase change processes and mass transfer.



**UNIT I CONDUCTION AND RADIATION HEAT TRANSFER 12**

One dimensional energy equations and boundary condition - three-dimensional heat conduction equations - extended surface heat transfer- various pin profiles- pin optimization - transient conduction-- conduction with moving boundaries - radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection

**UNIT II TURBULENT FORCED CONVECTIVE HEAT TRANSFER 12**

Momentum and energy equations - turbulent boundary layer heat transfer - mixing length concept - turbulence model – k Є model - analogy between heat and momentum transfer – Reynolds, Colburn, Prandtl turbulent flow in a tube - high speed flows.

**UNIT – III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER 12**

Condensation on bank of tubes - boiling – pool and flow boiling - heat Transfer Enhancement Techniques.

**UNIT – IV HEAT EXCHANGERS 12**

Heat Exchanger – Є- NTU approach and design procedure – compact heat exchangers – Plate heat exchangers– Mini and Micro Channel heat exchangers, Heat transfer correlations for specific cases.

**UNIT – V MASS TRANSFER 12**

Mass transfer - vaporization of droplets - combined heat and mass transfers applications – Cooling Towers, Evaporative condensers, solar pond, Cooling and dehumidification systems – porous media heat transfer

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES**

- On successful completion of this course the student will be able to understand the fundamental concept of heat transfer mechanisms.
- Understand the application of numerical methods in heat transfer applications.
- Knowledge in combined heat and mass transfer mechanisms in engine applications.

**REFERENCES**


1. Ghoshdastidar. P.S., Heat Transfer, Oxford University Press, 2004.
2. Holman.J.P., Heat Transfer, Tata Mc Graw Hill, 2002.
3. Incropera F.P. and DeWitt. D.P., Fundamentals of Heat & Mass Transfer, John Wiley & Sons, 2002.
4. Nag.P.K., Heat Transfer, Tata McGraw-Hill, 2002.
5. Ozisik. M.N., Heat Transfer – A Basic Approach, McGraw-Hill Co., 1985.
6. Yadav, R., Heat and Mass Transfer, Central Publishing House, 1995.
7. Yunus A.Cengal., Heat and Mass Transfer – A practical Approach, 3rd edition, Tata McGraw - Hill, 2007.


**TE4152 ADVANCED THERMODYNAMICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 4 |

**COURSE OBJECTIVES:**

- To achieve an understanding of basic principle and scope of thermodynamics.
- To predict the availability and irreversibility associated with the thermodynamic processes.
- To analyse the properties of ideal and real gas mixtures and to understand the basic concepts of thermal systems



**UNIT I THERMODYNAMIC PROPERTY RELATIONS 12**

Thermodynamic Potentials, Maxwell relations, Generalised relations for changes in Entropy, Internal Energy and Enthalpy, Generalised Relations for $C_p$ and $C_v$, Clausius Clapeyron Equation, Joule Thomson Coefficient, Bridgeman Tables for Thermodynamic Relations.

**UNIT II REAL GAS BEHAVIOUR AND MULTI-COMPONENT SYSTEMS 12**

Equations of State (mention three equations), Fugacity, Compressibility, Principle of Corresponding States, use of generalised charts for enthalpy and entropy departure, fugacity coefficient, Lee-Kesler generalised 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, Gibb's phase rule for non-reactive components.

**UNIT III AVAILABILITY ANALYSIS 12**

Introduction, Reversible work, Availability, Irreversibility and Second - Law Efficiency for a closed System and Steady-State Control Volume. Availability Analysis of Simple Cycles. Chemical availability of closed and control volume. Fuel Chemical availability, Evaluation of the availability of hydrocarbon fuels.

**UNIT IV FUEL – AIR CYCLES AND THEIR ANALYSIS 12**

Ideal Models of Engine Processes, Fuel–Air Cycle Analysis – SI Engine Cycle Simulation, CI Engine Cycle Simulation, Results of Cycle Calculations, Availability Analysis of Engine Processes – Availability Relationships – Entropy changes in Ideal Cycles – Availability Analysis of Ideal Cycles.

**TOTAL : 60 PERIODS**

**UNIT V THERMO CHEMISTRY 12**

Ideal gas laws and properties of Mixtures, Combustion Stoichiometry, Application of First Law of Thermodynamics – Heat of Reaction – Enthalpy of Formation – Adiabatic flame temperature. Second law of Thermodynamics applied to combustion – entropy, maximum work and efficiency Chemical equilibrium: - Equilibrium constant evaluation $K_p$&$K_f$, Equilibrium composition evaluation of ideal gas and real gas mixtures.

**COURSE OUTCOMES:**

On successful completion of this course the student will be able to

1. Apply the law of thermodynamics to thermal systems.
2. Analyse the actual thermodynamic cycles
3. Design and analyse a multi component thermodynamic system
4. Apply the thermodynamics concepts in automotive systems
5. Understand and analyse the combustion of different fuels

**REFERENCES:**


1. Kenneth Wark., J.R, Advanced Thermodynamics for Engineers, McGraw-Hill Inc., 1995.
2. K.Annamalai, I.K.Puri, M.A.Jog, Advanced Thermodynamics Engineering, Second Edition, CRC Press, 2011.
3. Advanced Thermodynamics, S.S. Thipse, Narosa Publishing Home Pvt. Ltd., 2013
4. Yunus A. Cengel and Michael A. Boles, Thermodynamics, McGraw-Hill Inc., 2006.
5. B.P. Pundir, I.C. engine combustion and emissions. Bejan, A., Advanced Engineering Thermodynamics, John Wiley and Sons, 1988.
6. Holman,J.P., Thermodynamics, Fourth Edition, McGraw-Hill Inc., 1988.




**RM4151 RESEARCH METHODOLOGY AND IPR L T P C**
**2 0 0 2**

**UNIT I RESEARCH DESIGN 6**

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

**UNIT II DATA COLLECTION AND SOURCES 6**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

**UNIT III DATA ANALYSIS AND REPORTING 6**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

**UNIT IV INTELLECTUAL PROPERTY RIGHTS 6**

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

**UNIT V PATENTS 6**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

**TOTAL :30 PERIODS**

**REFERENCES**

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

**IC4111 INTERNAL COMBUSTION ENGINES LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**COURSE OBJECTIVES:**

- To impart the knowledge on the practical aspects of Internal Combustion Engine Systems
- To impart the knowledge on the advanced engine technologies
- To understand the combustion, performance and emission behavior of SI and CI engine system at different load and speed conditions
- To understand the behavior of engine system at different operating conditions
- To understand the influence of after treatment system on emission reduction from engine systems
- To know the measurement of important fuel properties and its role



**LIST OF EXPERIMENTS**

1. Disassembly and Assembly of engines
2. Study of advanced diesel and gasoline engine technology engines
3. Study and drawing of engine components with dimensions.
4. Experimental investigation of combustion, performance and emission characteristics of spark ignition engine.
5. Experimental investigation of combustion, performance and emission characteristics of compression ignition engine
6. Determination of volumetric efficiency and equivalence ratio in a single cylinder D.I. Diesel engine.
7. Experimental study on the effect of fuel injection pressure on CI engine performance, combustion, and emission characteristics.
8. Experimental study on the effect of fuel injection timing on CI engine performance, combustion and emission characteristics.
9. Experimental study on the effect of preheating air and fuel on engine performance, combustion and emission characteristics.
10. Performance evaluation of After Treatment Systems
11. Determination of Flash and Fire point of various fuel blends.
12. Determination of Viscosity of various fuel blends.

**LABORATORY REQUIREMENTS**

1. Single or Multi Cylinder SI and CI Engine for disassembly and assembly
2. Engine Components for drawing and dimensioning
3. Single/ Multi-Cylinder S.I. Engine Test Rig with combustion and emission measurement facility
4. Single/ Multi-Cylinder C.I. Engines Test Rig with combustion and emission measurement facility

5. Exhaust Gas Analyser (To measure HC, CO, NOx, $O_2$, $CO_2$)
6. Smoke Meter
7. In cylinder Pressure Transducers, Charge Amplifiers, and crank angle encoders/crank sensor module with high speed data acquisition system
8. Open cup or Closed cup Flash and Fire Point Apparatus
9. Viscometer

**COURSE OUTCOMES:**

- Understand the various components of engine, its function, assembling of engine parts and working of advanced engine technologies
- Understand the procedures of conducting performance, combustion and emission test on engines and its significance
- Understand the method of calculating the volumetric efficiency and fuel-air ratio of an engine
- Understand the effect of various operating parameters of the engine on combustion, performance and emissions
- Understand the methods of calculating fuel properties

**TOTAL: 60 PERIODS**

| IC4001 | AUTOMOTIVE TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

- To distinguish different types of chassis, frames and body and its component design.
- To introduce the concept of aerodynamics in automobiles.
- To estimate the forces acting on vehicle during turning and acceleration.
- To identify various safety technologies incorporated in automobiles.
- To introduce the need for alternative power plants and its types.



**UNIT I VEHICLE STRUCTURE 9**

Basic construction of Chassis, types of Chassis layout, types of Body, types of frames, Loads acting on vehicle frame, materials for frames, testing of frames, Bharat New Vehicle Safety Assessment Program (BNVSAP) - Protocols.

**UNIT II AUTOMOTIVE AERODYNAMICS 9**

Automobile drag and types. Types of forces and moments – drag coefficient of automobiles – low drag profiles. Drag reduction techniques in cars and trucks. Wind Tunnel Testing & Measurement of Drag.

**UNIT III VEHICLE DYNAMICS 9**

Vehicle Dynamics – Steady state handling characteristics, Types of forces acting on a vehicle body, Roll centre, Roll axis, Vehicle under side forces, Calculation of Maximum acceleration, Reaction forces for different drives, Stability Control.

**UNIT IV SAFETY TECHNOLOGIES 9**

Antilock Braking System, Electronic Brake Force Distribution, Dual stage Airbag, Seatbelt Pre-tensioner, Dynamic Radar Cruise Control, Traction control system, Pre-Collision System, Automatic High Beam, Adaptive Headlights, Daytime Running Lamp, Active headrests, Crumple Zone

**UNIT V ALTERNATIVE POWER PLANT 9**

Need for Alternative power plants, Types of Hybrid Electric Vehicles – Series, parallel, split – parallel, series – parallel, Advantages and Disadvantages. Electric Vehicles – Classification and its characteristics. Power split device – Energy management system - Batteries, Fuel cells – Types, construction, principle of operation and characteristics.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

On successful completion of the course, the students will be able to:

1. Categorise various vehicles based on its chassis, body and know how vehicle testing is carried out.
2. Compute drag coefficients and recognise the need for drag reduction in automobiles.
3. Determine the various forces acting on the automobile and its effect while in motion.
4. Recognise the various safety technologies incorporated in automobiles and their pros and cons.
5. Distinguish the working of various alternate power plants for automobiles.

**REFERENCES:**


1. Joseph Heitner, “Automotive Mechanics”, 2nd Edition, CBS, 2006.
2. William H. Crouse, Donald L. Anglin, Automotive Mechanics, 10th Edition, McGraw Hill Education (India) Private Limited, 2006.
3. Heinz Heisler, “Advanced Vehicle Technology”, Butterworth-Heinemann, 2002
4. R.B. Gupta, Automobile Engineering, Satya Prakashan, 1993.
5. Hans B Pacejka, Tyre and Vehicle Dynamics, 2nd edition, SAE International, 2005
6. John C. Dixon, Tyres, Suspension, and Handling, 2nd Edition, Society of Automotive Engineers Inc, 1996
7. William B. Ribbens -Understanding Automotive Electronics, 5th edition- Butter worth Heinemann,1998
8. Hucho, W.H., Aerodynamics of Road vehicles, Butterworths Co Ltd., 4th Edition, SAE, 1998.
9. Iqbal Husain, Electric and Hybrid Vehicles, Design Fundamentals, CRC Press, 2003.
10. M. Ehsani, Y. Gao, S. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2005.




**IC4002 ADVANCED FLUIDS ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1) To introduce the concept of different types of fluid flow and its characteristics.
2) To model flows using analytical techniques.
3) To introduce the effect of boundary layers on a flow and its effect on the flow properties.
4) To distinguish the effects of pressure waves, flame propagation and special types of flow in engine.
5) To introduce different methods of flow visualisation techniques with its instrumentation.

**UNIT I INTRODUCTION TO FLUID FLOW 9**

Lagrangian and Eulerian approach, Newtonian Fluids, Non-Newtonian fluids, stokes’ law of viscosity, Navier – Stokes Equations, Compressible and Incompressible Flows, Ideal flows and Boundary layer flows – Introduction, Effect of swirl, squish and tumble flows in mixing of fuel and air. Characteristics of Low, Moderate and High Reynold number flows.

**UNIT II POTENTIAL FLOW 9**

Streamlines, Path lines, streak lines and time lines, Stream function and Velocity Potential function – Source, Sink and Doublet. Combination of flows - Rankine half body, Rankine full body, Vorticity, Rotational and Irrotational flows, Flow past a cylinder.

**UNIT III BOUNDARY LAYERS 9**

Laminar Boundary Layers – Approximate Integral Methods, Asymptotic Expansions and Triple Deck theory, 3D laminar boundary layer, unsteady boundary layers and Turbulent Boundary Layers. Velocity Profiles, Turbulent boundary layer on a flat plate, Turbulence Modelling – Introduction, Free Turbulence of Jets, wakes and mixing layers.

**UNIT IV COMPRESSIBLE FLOW AND SPEICAL FLOWS 9**

Compressible flow – Introduction, stagnation state, Finite pressure waves – effect on engine, Hagen – Poiseuille Flow and Couette Flow – applications in engine.

**UNIT V FLOW VISUALISATION 9**

Instrumentation - Schlieren photography – Laser Velocimetry – Illuminated Particle Visualisation Holography – Particle Image Velocimetry. Other Cold flow and combustion visualisation techniques. Numerical flow visualisation – Introduction.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES :**

On successful completion of this course, the students will be able to:

1) Use different approximations for the flow problem under consideration.
2) Model basic flows and develop codes for numerical flow visualization
3) Apply the concepts of viscous fluid flow for prediction of thickness of boundary layer and to predict overall flow characteristics.
4) Analyse compressible flow in engine like compression, knocking.
5) Select different flow visualisation techniques required for their experiments.

**REFERENCES:**


1. Ronald L. Panton, Incompressible flow, 3rd Edition, Wiley, 2005.
2. K. Muralidhar and G. Biswas, Advanced Engg. Fluid Mechanics, Narosa Publishing House, 2005.
3. Frank M. White, Viscous Fluid Flow, 3rd Edition, McGraw Hill, 2011.
4. I.G. Currie, Fundamental Mechanics of fluids, 4th Edition, McGraw Hill 2011.
5. F.P. Incropera and B. Lavine, Fundamentals of Heat and Mass Transfer, 7th Edition, Willey, 2011.
6. Welty, C. Wicks, Fundamentals of Momentum, Heat and Mass Transfer, 4th Edition, Wiley 2009.
7. J.P. Holman, Experimental Methods for Engineers, McGraw – Hill Inc., 2001.
8. Wolfgang Merzkirch, Flow Visualisation, 2nd Edition, Academic Press, 1987.
9. Marshall B. Long, Optical Methods in flow and Particle Diagnosis, Society of Photo Optics, 1989.
10. B.H. Lakshmana Gowda, A Kaleidoscopic view of Fluid Flow Phenomena, Wiley Eastern, 1992.
11. Will Schroeder, Ken Martin and Bill Lorensen, An Object – Oriented Approach to 3D Graphics, 2ndEdition, Prentice Hall, 1998.

**IC4003 SIMULATION OF I.C. ENGINE PROCESSES L T P C**
**3 0 0 3**

**COURSE OBJECTIVES:**

- To impart knowledge on simulation of various engine processes used in prime movers and power plants.
- To learn the simulation of engine combustion based on first and second law of thermodynamics.

**UNIT I SIMULATION PRINCIPLES 9**

First and second laws of thermodynamics – Estimation of properties of gas mixtures - Structure of engine models – Open and closed cycle models - Cycle studies. Chemical Reactions, First law application to combustion, Heat of combustion – Adiabatic flame temperature. Hess Law Lechatlier principle. Heat transfer in engines – Heat transfer models for engines. Simulation models for I.C. Engines. (Ideal and actual cycle simulation) Chemical Equilibrium and calculation of equilibrium composition.

**UNIT II SIMULATION OF COMBUSTION IN SI ENGINES 9**

Combustion in SI engines, Flame propagation and velocity, Single zone models – Multi zone models – Mass burning rate, Turbulence models – One dimensional model – Chemical kinetics modeling – Multidimensional models, Flow chart preparation.

**UNIT III SIMULATION OF COMBUSTION IN CI ENGINES 9**

Combustion in CI engines Single zone models – Premixed-Diffusive models – Wiebe' model – Whitehouse way model, Two zone models - Multizone models- Meguerdichian and Watson's model, Hiroyasu's model, Lyn's model – Introduction to Multidimensional and spray modeling, Flow chart preparation.

**UNIT IV SIMULATION OF TWO STROKE ENGINES 9**

Thermodynamics of the gas exchange process - Flows in engine manifolds – One dimensional and multidimensional models, Flow around valves and through ports Models for scavenging in two stroke engines – Isothermal and non-isothermal models, Heat Transfer and Friction.

**UNIT V SIMULATION OF GAS TURBINE COMBUSTORS 9**

Gas Turbine Power plants – Flame stability, Combustion models for Steady Flow Simulation – Emission models. Flow chart preparation.

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

On successful completion of this course the student will be able to

1. Simulate the SI engine processes
2. Simulate the CI engine processes
3. Simulate advance combustion concepts
4. Simulate the gas turbine processes
5. Simulate the different engine processes in 2 and 4 stroke engines**.**

**REFERENCES:**


1. Ashley S. Campbell, Thermodynamic Analysis of Combustion Engines, Krieger Publication co, 1985.
2. V.Ganesan, Computer Simulation of Spark Ignition Engine Processes, Universities Press, 2000.
3. V V. Ganesan, Computer Simulation of C.I. Engine Processes, Universities Press, 2000.
4. Cohen H. Rogers GEC. – Gas Turbine Theory – Pearson Education India Fifth edition, 2001.
5. Bordon P. Blair, The Basic Design of two-Stroke engines, SAE Publications, 1990.
6. Horlock andWinterbone, the Thermodynamics and Gas Dynamics of Internal Combustion Engines, Vol. I & II, Clarendon Press, 1986.
7. J.I.Ramos, Internal Combustion Engine Modeling, Butterworth – Heinemann ltd, 1999.
8. J.N.Mattavi and C.A.Amann, Combustion Modeling in Reciprocating Engines, Plenum Press,1980.

**IC4004** **L T P C**

**FUELS AND LUBRICANTS** **3 0 0 3**

**OBJECTIVES:**

1. To identify the processes behind fuel extraction system.
2. To understand the theory behind lubrication
3. To study the properties of lubricants.
4. To elaborate the properties of fuels used in IC engines.
5. To understand the need of fuel rating

**UNIT I MANUFACTURE OF FUELS AND LUBRICANTS 9**

Structure of petroleum, refining process, fuels, thermal cracking, catalytic cracking, polymerization, alkylation, isomerisation, blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants.

**UNIT II THEORY OF LUBRICATION 9**

Engine friction: introduction, total engine friction, effect of engine variables on friction, hydrodynamic lubrication, elasto hydrodynamic lubrication, boundary lubrication, bearing lubrication, functions of the lubrication system, introduction to design of a lubricating system

**UNIT III PROPERTIES AND TESTING OF LUBRICANTS 9**

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease.

**UNIT IV PROPERTIES AND TESTING OF FUELS AND COMBUSTION 9**

Thermo-chemistry of fuels, properties and testing of fuels, relative density, calorific value, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion etc. combustion in SI and CI Engine



**UNIT – V ADDITIVES FOR LUBRICANTS AND FUELS 9**

Additive - mechanism, requirements of additive, petrol fuel additives, diesel fuel additives and additive mechanism for lubricants. Introduction to Nano fluids

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**

Upon completion of this course, the students will be able to:

1. Identify the processes behind fuel extraction system.
2. Understand the theory behind lubrication
3. Study the properties of lubricants.
4. Elaborate the properties of fuels used in IC engines.
5. Understand the need of fuel rating and additives.

**REFERENCES:**


1. Ganesan. V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
2. M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.
3. A.R.Lansdown – Lubrication – A practical guide to lubricant selection – Pergamon press – 1982.
4. Raymond.C.Gunther – Lubrication – Chilton Book Co., - 1971.
5. Brame, J.S.S. and King, J.G. – Fuels – Solids, Liquids, Gaseous.
6. Francis, W – Fuels and Fuel Technology, Vol. I & II
7. Hobson, G.D. &Pohl.W- Modern Petroleum Technology

## AUDIT COURSES

**AX4091 ENGLISH FOR RESEARCH PAPER WRITING**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 0 |

**COURSE OBJECTIVES**

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

**UNIT I INTRODUCTION TO RESEARCH PAPER WRITING** **6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**UNIT II PRESENTATION SKILLS** **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

**UNIT III TITLE WRITING SKILLS** **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

**UNIT IV RESULT WRITING SKILLS** **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions



**UNIT V VERIFICATION SKILLS** **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES**

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

**REFERENCES**

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

**AX4092** **DISASTER MANAGEMENT** **L T P C**
**2 0 0 0**

**COURSE OBJECTIVES**

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

**UNIT I INTRODUCTION** **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS** **6**

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 PRONE AREAS IN INDIA** **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

**UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT** **6**

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**

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

**TOTAL : 30 PERIODS**

**COURSE OUTCOMES**

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

**REFERENCES**

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi,2001.

**AX4093** **CONSTITUTION OF INDIA** **L T P C**
**2 0 0 0**

**OBJECTIVES**

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

**UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION**

History, Drafting Committee, (Composition & Working)

**UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION**

Preamble, Salient Features

**UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND 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 IV 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 V LOCAL ADMINISTRATION**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

**UNIT VI ELECTION COMMISSION**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

**TOTAL: 30 PERIODS**

**OUTCOMES**

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

**SUGGESTED READING**


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

| AX4094 | நற்றமிழ் இலக்கியம் | L T P C<br>2 0 0 0 |
|---|---|---|

**UNIT I** **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
– எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
- இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
- போரை நிறுத்திய ஔவையார்

**UNIT II** **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
- அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
– ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல் )

**UNIT III** **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
- சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
- சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

**UNIT IV** **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
- பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
- அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
- இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
- சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
நற்றிணை (11) - நண்டு
கலித்தொகை (11) - யானை, புறா
ஐந்தினை 50 (27) - மான்
ஆகியவை பற்றிய செய்திகள்

**UNIT V** **நவீன தமிழ் இலக்கியம்** **6**

1. உரைநடைத் தமிழ்,
   - தமிழின் முதல் புதினம்,
   - தமிழின் முதல் சிறுகதை,
   - கட்டுரை இலக்கியம்,
   - பயண இலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

**TOTAL: 30 PERIODS**

**தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்**

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதின வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்