ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. AUTOMOBILE ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA & SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I. | Develop innovative automotive technologies to address specific needs of performance, comfort, safety and eco-friendliness. |
| II. | Apply computational tools for comprehensive understanding of the complex systems in automotive engineering. |
| III. | Update themselves to recent trends, technologies and industrial scenarios by pursuing lifelong learning. |

2. PROGRAMME OUTCOMES (POs):

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<th>PO</th>
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<tbody>
<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<tr>
<td>2</td>
<td>An ability to write and present a substantial technical report/document</td>
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<tr>
<td>3</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<td>4</td>
<td>Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice</td>
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<tr>
<td>5</td>
<td>Become familiar with modern engineering tools and analyze the problems within the domains of Automobile Engineering as the members of multidisciplinary teams</td>
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<td>6</td>
<td>Apply engineering knowledge, state-of-the-art tools and techniques to design and analyze automobile systems and sub-systems</td>
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Note: Program may add up to three additional Pos.

4. PEO / PO Mapping:

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Every programme objectives must be mapped with 1,2,3,-, scale against the correlation PO’s
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YEAR II

YEAR III

YEAR IV
# M.E. AUTOMOBILE ENGINEERING

## REGULATIONS 2021

### CHOICE BASED CREDIT SYSTEM

### I TO IV SEMESTERS CURRICULA AND SYLLABI

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**TOTAL 20 1 8 29 23**

* Audit Course is optional.

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**TOTAL 17 0 12 29 21**

* Audit Course is optional.
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**PRACTICAL**

| 5.      | AM4311      | Project Work I               | EEC      | 0 0 12           | 12                    | 6       |
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| 1. AM4411 | Project Work II | EEC       | 0 0 24          | 24                  | 12      |

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE - 74**
## FOUNDATION COURSES (FC)

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**TOTAL CREDITS** | 33

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**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

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**AUDIT COURSES (AC)**

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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


UNIT II  ORDINARY DIFFERENTIAL EQUATIONS


UNIT III  FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS


UNIT IV  FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS

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


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:

AM4101 AUTOMOTIVE CHASSIS AND DRIVE LINE SYSTEMS

COURSE OBJECTIVES:
- To understand the basic knowledge about various vehicle frames, front axles, steering systems and understand the conditions for true rolling motion of wheels during steering.
- To recognize the construction and working principle of drive line, final drive, differential and suspension systems.
- To review the knowledge about the constructional feature of rear axle, wheels, tyres and braking systems.
- To impart knowledge on detailed concept, construction and principle of operation of various types of mechanical transmission components.
- To design and select Hydrodynamic Transmission for various applications.

UNIT I CLUTCH & GEAR BOX
Different types of clutches and requirement of transmission system – Principle, construction, torque capacity and design aspects of friction clutches – Objective of the gear box - Different types of gear boxes - Determination of gear box ratios & design of gear box for different vehicle applications – Typical problems.

UNIT II DRIVE-LINE STUDY, FRONT AXLE & REAR AXLE

UNIT III STEERING, SUSPENSION, WHEELS AND BRAKING SYSTEM
UNIT IV HYDRO-DYNAMIC, HYDRO-STATIC & ELECTRIC DRIVES

UNIT V AUTOMATIC TRANSMISSION, OVERDRIVE, HYDRAULIC CONTROL SYSTEMS AND APPLICATIONS

COURSE OUTCOMES:
At the end of this course the student will be able to
• Identify the different types of frame and chassis used in Automotive.
• Relate different types of drive lines, drives and braking systems used in Automotive.
• Acquire knowledge about different types of front axle, rear axles and suspension systems used in motor vehicles.
• Examine the usage of Hydrodynamic devices, hydrostatic devices, automatic transmission system
• Understand Electric drive used in road vehicles automatic transmission system.

REFERENCES
3. SAE Transactions 900550 & 930910
5. Birch, Automotive Braking Systems, Thomson Asia, 1999
7. Birch, Automotive Suspension and Steering Systems, Thomson Asia, 1999
10. John Peter Whitehead, Donald Bastow, Car Suspension and Handling, 4th Edition, Allied publishers limited, SAE Department, 2004
COURSE OBJECTIVES:
- To impart knowledge on engine operation and its constructional details
- Understand various subsystems involved in engine operation
- To impart knowledge to design and analyse engine operating parameters like air fuel ratio, injection parameters etc
- Understand the concept of combustion and its effects under various conditions
- To impart knowledge on recent developments on IC engines.

UNIT I ENGINE BASIC THEORY
Introduction - Engine types – Operating cycle - otto, diesel, dual operating cycles – Fuel air cycle and actual cycles — Two and four stroke engines - Engine design and operating parameters - Typical performance and pollution curves for automobile engines.

UNIT II FUEL SUPPLY AND IGNITION SYSTEMS
Objective and theory of carburetion - carburetors, Types, Additional system and modern devices of carburetor — Calculation of air fuel ratio of carburetor - Diesel fuel injection objective and types - pumps and injectors, Introduction to Petrol Injection system - conventional ignition systems, advance mechanisms.

UNIT III AIR MOTION, COMBUSTION AND COMBUSTION CHAMBERS

UNIT IV ENGINE COOLING, LUBRICATING SYSTEMS AND SUPERCHARGING, TURBOCHARGING

UNIT V NEW ENGINE TECHNOLOGY

COURSE OUTCOMES:
- Students will have the basic knowledge on Automotive Engines and its various sub systems along with its functions.
- Student can able to design and solve engine related problems
- Student will have command knowledge over recent development in the area of internal combustion engines.
- Student can apply their knowledge to analyse and correlate the data with recent requirements of automobile industry
- Student to can explore new alternate fuels or energy system to run the automobile

TOTAL : 45 PERIODS
REFERENCES:

AM4103 AUTOMOTIVE ELECTRICAL AND ELECTRONICS L T P C
3 0 0 3

COURSE OBJECTIVES:
• To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems
• To understand the need for starter batteries, starter motor and alternator in the vehicle.
• To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
• To list common types of sensor and actuators used in vehicles.
• To understand dash – Board Instruments, various sensors and networking in vehicles.

UNIT I BATTERY AND STARTING SYSTEMS

UNIT II CHARGING AND LIGHTING SYSTEMS
D.C. Generators and Alternators their Characteristics, Control cutout, Electrical, Electromechanical and electronic regulators. Regulations for charging. Wiring Requirements, Insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods. Lighting design.

UNIT III ELECTRONIC IGNITION AND INJECTION SYSTEMS

UNIT IV ELECTRICAL SYSTEMS
Warning and alarm instruments : Brake actuation warning system, traficators, flash system, oil pressure warning system, engine over heat warning system, air pressure warning system, speed warning system, door lock indicators, neutral gear indicator, horn design, permanent magnet horn, air & music horns. Wind shield wiper, window washer, instrument wiring system and electromagnetic interference suppression, wiring circuits for instruments, electronic instruments, dash board illumination.
UNIT V SENSORS, ACTUATORS AND MICROPROCESSOR IN AUTOMOBILES 9


TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of this course the student should be able to
• Define the glossary related to vehicle electrical and electronic system
• Understand the need for starter batteries, starter motor and alternator in the vehicle.
• Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
• List common types of sensor and actuators used in vehicles.
• Understand networking in vehicles.

REFERENCES:

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


UNIT V PATENTS


TOTAL :30 PERIODS

REFERENCES

AM4111 ENGINE AND CHASSIS COMPONENTS LABORATORY

COURSE OBJECTIVES:
- To assemble and disassemble the parts of an IC engine.
- To identify the various component of an IC engine.
- To identify the various components in transmission systems of an automobile.
- To assemble and disassemble the various components of transmission system.

LIST OF EXPERIMENTS
1. To assemble and disassemble 1000CC engine
2. To assemble and disassemble six cylinder engine
3. To assemble and disassemble V8 engine
4. To assemble and disassemble CRDI engine
5. To assemble and disassemble MPFI engine
6. To assemble and disassemble Single plate, Diaphragm Clutch.
7. To assemble and disassemble Constant mesh, Sliding mesh gear box
8. To assemble and disassemble Transfer case
9. To assemble and disassemble Differential, Rear axle
10. To assemble and disassemble Front axle.
11. To Study different chassis layouts
12. To Study braking system
13. To Study Steering system
14. To Study Suspension system

TOTAL: 60 PERIODS
COURSE OUTCOMES:
- Dismantle and Assemble the automobile chassis and Engine components
- Identify & differentiate components of SI & CI engines
- Understand working of braking, steering, clutch, transmission, Suspension systems.
- Differentiate various subsystems of two, three & Four wheeler vehicles
- Develop skills in Dismantling and assembling of chassis components.
- Correct minor repairs and trouble shoots the breakdowns.

AM4112 AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY  L T P C  0 0 4 2

COURSE OBJECTIVE:
To import the knowledge in the area of automotive electrical system and electronic system associated in modern vehicles.

LIST OF EXPERIMENTS:
1. Testing of
   a. battery
   b. starting systems
   c. charging systems
   d. ignition systems
   e. body controller systems
2. Study of a. automotive lighting system and adjustment of head lights beam
   a. major electrical components used in modern vehicles
   b. diagnostic tool used in vehicle
3. Dismantling, testing and assembling of Starter system components
4. Dismantling, testing and assembling of charging system components
5. Basic Analog Experiments like
   a. Logic gates, Adders, Flip flops
   b. Amplifier, filter,
   c. Multiplexer and De-multiplexer
6. Interfacing seven segment displays
7. Microprocessor and microcontroller programming
   a. Arithmetic and Logic operation,
   b. Code conversion,
   c. Waveform generation,
   d. Look up table
8. Interfacing ADC and DAC for Data Acquisition and Control Application
9. Interfacing Sensors for Measurements of position, displacement, velocity, force, temperature, proximity/range

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to have the knowledge in
- Automotive electrical systems and electrical accessories
- Basic microprocessor / microcontroller programming
- Automotive sensor, transducer, actuator, virtual instrumentation, data acquisition
- Development of embedded systems for automobiles
OBJECTIVES:
- To discuss the harmful effects of major pollutants on living beings and the environment
- To analyse the formation of major pollutants like UBHC, CO, NOx, particulate matter and smoke.
- To design various control techniques to reduce pollutants in combustion
- To determine the various after treatment process to minimize emissions
- To demonstrate the various devices used to measure pollutants and discuss the Emission standards followed in various nations

UNIT I EMISSIONS FROM AUTOMOBILES 5

UNIT II EMISSIONS FROM SPARK IGNITION ENGINE AND ITS CONTROL 12
Emission formation in SI Engines- Carbon monoxide- Unburned hydrocarbon, NOx, Smoke — Effects of design and operating variables on emission formation — controlling of pollutants -Catalytic converters — Charcoal Canister — Positive Crank case ventilation system, Secondary air injection, thermal reactor, Laser Assisted Combustion.

UNIT III EMISSIONS FROM COMPRESSION IGNITION ENGINE AND ITS CONTROL 12
Formation of White, Blue, and Black Smokes, NOx, soot, Sulphur particulate and Intermediate Compounds – Physical and Chemical delay — Significance Effect of Operating variables on Emission formation — Fumigation, EGR, HCCI, Particulate Traps, SCR — Cetane number Effect.

UNIT IV NOISE POLLUTION FROM AUTOMOBILES 8

UNIT V TEST PROCEDURES AND EMISSION MEASUREMENTS 8
Constant Volume Sampling 1 and 3 (CVSI & CVS3) Systems- Sampling Procedures — Chassis dyno - Seven mode and thirteen mode cycles for Emission Sampling — Sampling problems — Emission analyzers —NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

TOTAL : 45 PERIODS

OUTCOMES:
By the end of this course, students will be able to
- Differentiate the various emissions formed in IC engines
- Analyze the effects of pollution on human health and environment
- Design the control techniques for minimizing emissions
- Categorize the emission norms
- Identify suitable methods to reduce the noise emissions.

REFERENCES

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AM4202 DYNAMICS OF ROAD VEHICLES

**OBJECTIVES:**
- To provide fundamental knowledge of the vibration,
- To impart knowledge on tyres
- To provide basic concepts on suspension design and function, ride modes
- To Evaluate the performance, longitudinal dynamics and control in an automobile
- To provide basic analysis on handling, cornering stability and control

**UNIT I CONCEPT OF VIBRATION**

**UNIT II TYRES**

**UNIT III VERTICAL DYNAMICS**

**UNIT IV LONGITUDINAL DYNAMICS AND CONTROL**
Aerodynamic forces and moments. Equation of motion. Load distribution for three-wheeler and four-wheeler. Calculation of maximum acceleration, tractive effort and reaction forces for

UNIT V LATERAL DYNAMICS

OUTCOMES:
At the end of the courses, the students can able to
- Develop physical and mathematical models of a mechanical vibrating system
- Indicate the forces and moment acting on tyres
- Identify the suspension parameters that governs ride comfort
- Evaluate the vehicle performance in longitudinal direction
- Evaluate the lateral dynamics and control in an automobile

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OBJECTIVES:
- To acquire knowledge on Different aspects of car body,
- To acquire knowledge on bus body and commercial vehicle bodies.
- To acquire knowledge on Role of various aerodynamic forces and moments, measuring instruments in vehicle body design.
- To acquire knowledge on Material used in body building,
- To acquire knowledge on Tools used in body repairs and command over vehicle body engineering applications.

UNIT I  CAR BODY DETAILS
Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car –
car body terminology - Visibility- regulations, driver’s visibility, improvement in visibility and
tests for visibility. Driver seat design -Car body construction-Various panels in car bodies.
Safety: Safety design, safety equipment for cars. AIS and SAE car body Regulations

UNIT II  BUS BODY DETAILS
Types of bus body: based on capacity, distance travelled and based on construction.– Bus
body lay out, floor height, engine location, entrance and exit location. Types of metal
sections used –Constructional details: Conventional and integral. AIS and SAE bus body
Regulations

UNIT III  COMMERCIAL VEHICLE DETAILS
Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of
Flat platform body, Tipper body and Tanker body – Dimensions of driver’s seat in relation to
controls – Drivers cab design.

UNIT IV  VEHICLE AERODYNAMICS
Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces
and moments. Side wind effects on forces and moments. Various body optimization
techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel
testing such as: Flow visualization techniques, Airflow management test – measurement of
various forces and moments by using wind tunnel balance.

UNIT V  BODY MATERIALS, TRIM, MECHANISMS AND BODY REPAIR
Types and properties of materials used in body construction and insulation -Such as steel
sheet, timber, plastics and GRP, Insulation materials. Body trim items-body mechanisms.
Hand tools-power tools for body repair. Vehicle corrosion-Anticorrosion methods-Modern
painting process procedure.

OUTCOMES:
The students will be able to
- Discuss the different aspects of car body and its safety features.
- Categorize the various bus body based on construction and correlate its safety
  features.
- Categorize the construction of commercial vehicle bodies.
- Calculate the various aerodynamic forces and moments, and relate the working of
  measuring instruments in calculating the aerodynamic forces.
- Demonstrate the tools used in body repairs and command over the usage of material
  in body building.
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AM4204 ELECTRIC AND HYBRID VEHICLES

OBJECTIVES:
The course should enable the students to:
1. General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing, sub-system design and hybrid vehicle control.
2. Understand about vehicle dynamics,
3. Design the required energy storage devices,
4. Select the suitable electric propulsion systems and
5. Understand of hybrid electric vehicles.

UNIT I NEED FOR ALTERNATIVE SYSTEM
Need for hybrid and electric vehicles — main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES
Design requirement for electric vehicles: Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance - Transmission efficiency - Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems

UNIT III ENERGY SOURCES
UNIT IV   MOTORS AND CONTROLLERS
Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM
motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring,
Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT V   SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES
Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid

OUTCOMES:
The students will be able to
• Understand working of different configurations of hybrid and electric vehicles
• Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
• Choose proper energy storage systems for vehicle applications
• Choose a suitable drive scheme for developing an electric hybrid vehicle depending on
  resources
• Understand basic operation of power-split device in hybrid electric vehicle.

TEXT BOOKS:

REFERENCES:
   Sons, 2003
   Publication, 2005

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OBJECTIVES:
- To impart knowledge in automotive Emission measurement and methods of testing engines.
- To categorize the different measuring techniques of pollutants like UBHC, CO, NOx, CO2 and smoke.
- To investigate the performance and combustion parameters for different engine models.
- To learn removal and fitting of automotive accessories.
- To understand the adjustment of play in various automobile components.

LIST OF EXPERIMENTS ON ENGINE TESTING:
1. Performance test and study on SI engine.
2. Performance test and study on diesel engine.
3. Determine the Frictional power by motoring test on petrol engines.
4. Heat balance test on Diesel engine.
5. Determination of Volumetric efficiency on diesel Engine.
6. Retardation Test On 4-Stroke, Single Cylinder Diesel Engine Test Rig
7. Morse test to determine Indicated power for multi-cylinder SI Engine

LIST OF EXPERIMENTS ON VEHICLE TESTING:
1. Tightening and adjustment of wheel bearing.
2. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel orientation.
3. Wheel alignment in four wheelers.
4. Service of transmission, braking and suspension systems.
5. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system.
6. Work on body and paint shop.

TOTAL: 60 PERIODS

OUTCOMES:
- Analysis of combustion parameters
- Differentiate the variation performance parameters of diesel engines
- Differentiate the variation performance parameters of diesel engines
- Learn removal and fitting of automotive accessories
- Understand the adjustment of play in various automobile components.

OBJECTIVES:
- To familiarize the students to use modelling software for modelling engine components
- To design chassis components with dimensions and strength requirements.
- To learn the use of standard practices in modelling of components.
- The use of modelling software to control the quality of the final engineered product.
- To visualize the complete assembly of the various system.

LIST OF ENGINE DESIGN EXPERIMENTS
1. Design and modelling of piston, piston pin and piston rings.
2. Design modelling of the connecting rod assembly.
3. Design of crankshaft, balancing weight calculations and modelling of the crankshaft assembly.
5. Design and modelling of the inlet and exhaust valves.
6. Design and modelling of cam and camshaft.
7. Design and modelling of combustion chamber.

LIST OF CHASSIS DESIGN EXPERIMENTS
8. Design and modelling of frame
10. Design and modelling of constant mesh gearbox
11. Design and modelling of sliding mesh gearbox
13. Design and modelling of rear axle

TOTAL: 60 PERIODS

OUTCOMES:
Students will be able to
• visualize the automotive components with the help of modelling software.
• make the modifications instantly if required at the initial stage itself
• synthesize, analyse and document the design of the various components

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AM4301 ENGINE MANAGEMENT SYSTEMS

OBJECTIVES:
• To impart knowledge on engine management systems viz fuel injection, ignition system.
• To understand various controlling system for emission control and engine operation
• To provide opportunities to discuss the fundamentals of engine control sensors and actuators,
• To identify and analyze electric and electronic related problems
• To distinguish various engine control algorithm used during engine operation.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS
Components for electronic engine management system, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.
UNIT II          SENSORS AND ACTUATORS
Inductive, Hall Effect, thermistor, piezo electric, piezoresistive, based sensors. Throttle position, mass air flow, crank shaft position, cam position, engine speed sensor, exhaust oxygen level (two step, linear lambda and wideband), knock, manifold temperature and pressure sensors. Solenoid, relay (four and five pin), stepper motor

UNIT III              SI ENGINE MANAGEMENT
Layout and working of SI engine management systems. Group and sequential injection techniques. Advantages of electronic ignition systems. Types of solid-state ignition systems and their principle of operation, Contactless (BREAKERLESS) electronic ignition system, electronic spark timing control.

UNIT IV             CI ENGINE MANAGEMENT

UNIT V               DIGITAL ENGINE CONTROL SYSTEM
Cold start and warm up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cutoff. Fuel control maps, open loop and closed loop control – Integrated engine control system, Electromagnetic compatibility – EMI Suppression techniques – Electronic dash board instruments – Onboard diagnosis system.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should able to
- Explain the fundamentals, operation, function of various electronic components, control techniques in an engine management system.
- Explain the fundamentals, operation, function of various sensors and actuators in an engine management system.
- Explain the fundamentals, operation, function of various fuel injection system pertain to a SI Engine.
- Explain the fundamentals, operation, function of various fuel injection system pertain to a CI Engine.
- Explain the control algorithm during various engine operating conditions.

REFERENCES:
2. Tom Denton, Automobile Electrical and Electronic Systems, Taylor & Francis, 5th Edition, 2018
3. Automobile Electronics by Eric Chowanietz SAE

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AM4001  VEHICLE DESIGN  L T P C  3 0 0 3

COURSE OBJECTIVES:

- To understand the various steps involved in the design of automotive components
- To show their knowledge in designing engine components.
- To complete design exercise and arrive at important dimensions of chassis components.
- To learn the use of standard practices in design.
- To determine the dimensions of front and rear axles

UNIT I  DESIGN OF CYLINDER, PISTON AND CONNECTING ROD  10
Choice of material for cylinder and piston, design of cylinder, design of piston, piston pin, piston rings and piston assembly. Material for connecting rod, design of connecting rod assembly. Case study on design of piston for passenger car.

UNIT II  DESIGN OF CRANK SHAFT AND VALVES  9

UNIT III  DESIGN OF CLUTCHES AND GEARS  10

UNIT IV  DESIGN OF VEHICLE FRAME AND SUSPENSION  6
Study of loads-moments and stresses on frame members. Design Of frame for passenger and commercial vehicle - Design of leaf Springs-Coil springs and torsion bar springs. Case study on development of frame for ATV.

UNIT V  DESIGN OF FRONT AND REAR AXLE  10

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

- Analyse the stress and strain imparted on automotive components
- Compute the design and find the dimension of the vehicle components.
- Identify optimal design solutions to real-world problems in compliance with industry standards.
- Demonstrate the design skill by creating new design strategy with the application of the knowledge.
- Interpret the modern system in vehicle and would help in developing the system with less impact to the environment.

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AM4002 AUTOMOTIVE MATERIALS

COURSE OBJECTIVES
The course should enable the students to:
- Select suitable materials for design
- Understand the concepts of heat treatment and surface modification techniques
- Gain knowledge on materials and their applications in automotive applications
- Analyze the properties of different materials used for automotive structures, engine and transmission systems.
- Gain knowledge on advanced metallic and non-metallic materials.

UNIT I INTRODUCTION
Elasticity-forms – Stress and strain relationship in engineering materials - Deformation mechanism - Strengthening material - Strain hardening, alloying, polyphase mixture, martensitic precipitation, dispersion, fiber and texture strengthening - iron carbon diagram.

UNIT II METALLIC MATERIALS
Cast irons - types, properties, structures, compositions and applications, plain carbon steels, low alloy steels and effects of alloying elements, high alloy steels, stainless steel types, castability, formability, machinability, hardenability and weldability of the material, high temperature steels and super alloys. Decorative and functional coating materials for automotive parts - Electro less Nickel, Hard Chrome, and, Zirconium Phosphate, Zinc flake, Metal oxides.

UNIT III COMPOSITES
UNIT IV  ELECTRICAL AND MAGNETIC MATERIALS

UNIT V  RUBBER AND PLASTICS MATERIALS

TOTAL: 45 PERIODS

COURSE OUTCOMES
The student will be able to:

- Understand failure mechanisms.
- Gain knowledge on different class of materials and their applications.
- Understand the Selection criteria for various components and importance.
- Select proper material for Automobile applications.
- Understand different materials used for sensors in a vehicle.

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COURSE OBJECTIVES:

- To enhance the knowledge of the students about the various equipment's used in earth moving, applications.
- To understand the construction and working of the vehicle for constructional application
- To describe the working nature of farm equipment's based on their application.
- To discriminate the various industrial vehicles based on the purpose.
- To acquire the knowledge on the functioning of military vehicle.

UNIT I  EARTH MOVING EQUIPMENTS  9
Construction layout, capacity, specification and applications of dumpers, articulated haulers, front-end loaders, backhoe loaders, bulldozers, scrapers, motor graders, skid steer loaders, excavator, hydraulic shovels, bucket conveyors, surface miners – highwall Miners. Selection criteria for prime mover.

UNIT II  CONSTRUCTIONAL EQUIPMENTS  10
Construction layout, capacity, specification and applications of cranes – types, Articulated Trucks, concrete ready mixer, trenchers, Asphalt Pavers, road reclaimers, General description, specification and functions of smooth wheeled rollers, pneumatic tired rollers, sheep's foot rollers, vibrating compactors, draglines, drillers, borewell machine

UNIT III  FARM EQUIPMEMTS  9
Classification of tractors – Main components of tractor. Working attachment of tractors – Auxiliary equipment. Top lifting harvesters, General description, working, specification and functions of paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT IV  INDUSTRIAL VEHICLE  9
General description, specification, capacity and working of fork lifts - attachment, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, fire fighting vehicle, reclaimers, Street sweepers

UNIT V  MILITARY AND COMBAT VEHICLES  8
Special features and constructional details of Main Battle tank, gun carriers, truck-mounted missile launchers, transport vehicles, armoured vehicle-launched bridge, amphibious bridging vehicle, and communication vehicles.

COURSE OUTCOMES:
The students will be able to

- Demonstrate their understanding about the operation of the various special purpose vehicle
- Understand the construction layout of earth moving equipment’s.
- Have the ability to apply the knowledge to design a new concept for construction application.
- Demonstrate their skill in developing modern techniques for future farming vehicles
- Distinguish the various military vehicle and infer their particular technology.

REFERENCES:

4. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.

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**AM4004** INSTRUMENTATION AND EXPERIMENTAL TECHNIQUES

**UNIT I** MEASUREMENT SYSTEMS
Static and Dynamic Measurement systems-importance of measurement system – methods of measurement - applications - characteristics of measuring system-static and dynamic characteristics of measuring system – Analysis of experimental detail, Error analysis-types of errors-limiting errors

**UNIT II** TRANSUDCERS, MODIFIERS AND TERMINATING DEVICES
Transducers for Automotive Applications – Amplifiers-Classifications and application in automobile – filters -types – Data Acquisition system - analog and digital type DAS-Indicators, Printers and display device –Signal Analyzing with example of automobile applications.
UNIT III  MECHANICAL MEASUREMENT  10
Instrumentation for Measuring Weight, Force, torque, pressure, power, temperature, fluid flow and special methods, vibration piezo electric effect, rotational speed. Measuring Velocity, acceleration and angular motion with respect to automobile applications.

UNIT IV  ENGINE EXPERIMENTAL TECHNIQUES  10

UNIT V  VEHICLE EXPERIMENTAL TECHNIQUES  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course the student should be able to
- Understand the components of the automotive instruments and their functions and the latest developments in this field
- Understand transducers, modifiers and terminating devices
- Understand mechanical measurement
- Grasp the basics of engine experimental techniques
- Grasp the basics of vehicle experimental techniques

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COURSE OBJECTIVES:
- To identify the processes behind fuel extraction system.
- To understand the theory behind lubrication
- To study the properties of lubricants.
- To elaborate the properties of fuels used in IC engines.
- 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
Additives and additive mechanism, for lubricants. Introduction to Nano fluids

OUTCOMES:
At the end of this course the student should be able to
- Identify the processes behind fuel extraction system.
- Understand the theory behind lubrication
- Study the properties of lubricants.
- Elaborate the properties of fuels used in IC engines.
- Understand the need of fuel rating.

REFERENCES
COURSE OBJECTIVES:
- To identify the key factors in designing experiments
- To develop appropriate experimental design
- To analyse the data to derive valid conclusions.
- To optimize process conditions by developing empirical models.
- To Design robust products and processes using parameter design approach.

UNIT I  FUNDAMENTALS OF EXPERIMENTATION 9
Role of experimentation in rapid scientific progress, Historical perspective of experimental approaches, Steps in experimentation, Principles of experimentation.

UNIT II  SIMPLE COMPARATIVE EXPERIMENTS 9
Basic concepts of probability and statistics, Comparison of two means and two variances, Comparison of multiple (more than two) means & ANOVA.

UNIT III  EXPERIMENTAL DESIGNS 9
Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays & interaction tables, modifying the orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data.

UNIT IV  RESPONSE SURFACE METHODOLOGY 9
Concept, linear model, steepest ascent, second order model, regression

UNIT V  TAGUCHI’S PARAMETER DESIGN 9
Concept of robustness, noise factors, objective function & S/N ratios, inner-array and outer-array design, data analysis

TOTAL : 45 PERIODS

COURSE OUTCOMES:
- Formulate objective(s) and identify key factors in designing experiments for a given problem.
- Develop appropriate experimental design to conduct experiments for a given problem.
- Analyze experimental data to derive valid conclusions.
- Optimize process conditions by developing empirical models using experimental data.
- Design robust products and processes using parameter design approach.

REFERENCES
OBJECTIVES:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions
- To understand the assembly of global arrays, and solution of the resulting algebraic systems.
- Understand how to use finite element analysis in engineering problems and application areas including stress, heat transfer, and vibration analysis

UNIT I  INTRODUCTION

UNIT II  1D ELEMENTS

UNIT III  2D ELEMENTS

UNIT IV  STRUCTURAL AND DYNAMIC ANALYSIS

UNIT V  HEAT TRANSFER ANALYSIS AND FLOW ANALYSIS
1D & 2D problems in fluid mechanics and heat transfer by conduction and convection. Transient thermal analysis. Case Studies like Heat transfer analysis of piston, fins.

TOTAL : 45 PERIODS

OUTCOMES:
Upon completing this course, the students will be able to:

- Identify mathematical model for solution of common engineering problems.
- Formulate simple problems into finite elements.
- Solve structural, thermal, fluid flow problems.
- Use professional-level finite element software to solve engineering problems in Solid mechanics, fluid mechanics and heat transfer.
- Derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts.
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REFERENCES

AM4008 NOISE, VIBRATION AND HARSHNESS FOR AUTOMOBILES L T P C
3 0 0 3

OBJECTIVES:
The course should enable the students to:
1. To introduce source of noise and vibration
2. To broaden the understanding of sound measurement and human sensitivity
3. To underline the importance of simulation, anechoic chamber and acoustic holography
4. To broaden the importance of statistical and frequency analysis
5. To introduce active control techniques

UNIT I NVH IN THE AUTOMOTIVE INDUSTRY

UNIT II SOUND AND VIBRATION THEORY

UNIT III TEST FACILITIES AND INSTRUMENTATION
Laboratory simulation: rolling roads (dynamometers), road simulators, semi-anechoic rooms, wind tunnels, etc. Transducers, signal conditioning and recording systems. Binaural head recordings. Sound Intensity technique, Acoustic Holography, Statistical Energy Analysis
UNIT IV  SIGNAL PROCESSING  

UNIT V  NVH CONTROL STRATEGIES & COMFORT  

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course the student will be able to:
1. Identify sources of noise and vibration
2. Measure sound intensity and human sensitivity
3. Carryout statistical energy analysis and simulators
4. Determine active control techniques
5. Carryout statistical and frequency analysis barrier.

REFERENCES:

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The objective of this course is to make the students to
- analyse various two wheelers and their dynamics
- design the power unit of two and three wheelers
- apply the design aspects of transmission system
- understand different frames and suspension system used in two wheelers.
- Emphasize the knowledge on three wheelers and its sub systems

UNIT I INTRODUCTION 
9
Classifications of different two wheelers based on usage - design considerations – weight and dimension limitations –requirements, stability problems, gyroscopic effect- pendulum effect of two and three wheelers. Introduction to All-terrain vehicles.

UNIT II POWER UNITS, IGNITION SYSTEMS AND OTHER ELECTRICAL SYSTEMS 
10

UNIT III CLUTCHES AND TRANSMISSION 
10

UNIT IV FRAMES, SUSPENSION, WHEELS, TYRES AND BRAKES 
8

UNIT V THREE WHEELERS 
8
Case study on Auto rickshaw - different types, Pick-Ups and delivery type vehicles, frames and transmission in three wheelers, wheel types, wheel mountings attachment, tyre types. Brake systems.

TOTAL : 45 PERIODS

OUTCOMES 
At the end of the course the students will be able to
- Analyse various two wheelers and its technology along with its functions.
- Design power plant for different two and three wheelers.
- Design and analyse transmission units used in two wheelers.
- Analyse different frames and suspension system used in two wheelers.
- Analyse and design the frames and suspension of three wheelers.

REFERENCES:
7. Build Your Own Electric Motorcycle, By Carl Vogel,2009
AM4010 HYDROGEN AND FUEL CELLS FOR AUTOMOBILES  L T P C

OBJECTIVES:
The course should enable the students:
- To Describe the different production and storage methods of hydrogen.
- To Explain the methods related to usage of hydrogen in SI Engines.
- To Explain the methods related to usage of hydrogen in CI Engines.
- To Illustrate the technical features of fuel cells for automotive applications
- To Outline the design concepts of hydrogen fuel cell systems for road vehicles

UNIT I HYDROGEN AS FUTURE ENERGY CARRIER

UNIT II HYDROGEN IN S.I. ENGINE SYSTEM

UNIT III HYDROGEN IN C.I. ENGINE SYSTEM

UNIT IV FUEL CELLS FOR AUTOMOTIVE APPLICATIONS
Basic Concepts of Electrochemistry - Proton Exchange Membrane Fuel Cells: Membrane-Electrocatalysts- GDL- Bipolar Plates - Sensitivity of PEM Stacks to Operating Conditions: Polarization Curve- Effect of Operative Parameters on the Polarization Curve - Durability of PEM Fuel Cells

UNIT V DESIGN OF HYDROGEN FUEL CELL SYSTEMS

TOTAL : 45 PERIODS
OUTCOMES
At the end of the course the students will be able to
• Describe the different properties- production and storage methods of hydrogen.
• Explain the concept- methods and various features related to usage of hydrogen in SI Engines.
• Explain the concept- methods and various features related to usage of hydrogen in CI Engines.
• Illustrate the technical features of fuel cells for automotive applications
• Outline the design concepts of hydrogen fuel cell systems for road vehicles

REFERENCES:

Mapping of CO and PO

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Table: Course Outcomes (CO) vs Programme Outcomes (PO)
COURSE OBJECTIVES:

- This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion. It will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
- To develop finite volume discretised forms of the governing equations for diffusion processes.
- To develop finite volume discretised forms of the convection-diffusion processes.
- To develop pressure-based algorithms for flow processes.
- To introduce various turbulence models, Large Eddy Simulation and Direct Numerical Simulation.

UNIT – I GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES

UNIT – II DIFFUSION PROCESSES: FINITE VOLUME METHOD

UNIT – III CONVECTION-DIFFUSION PROCESSES: FINITE VOLUME METHOD
One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

UNIT – IV FLOW PROCESSES: FINITE VOLUME METHOD
Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms.

UNIT – V TURBULENCE MODELS
Turbulence – RANS equation - Algebraic Models, One equation model, Two equation models – k & standard k – ε model, Low Reynolds number models of k- ε, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes.

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

- Analyse the governing equations and boundary conditions.
- Analyse various discretization techniques for both steady and unsteady diffusion problems.
- Analyse the various convection-diffusion problems by Finite-Volume method.
- Analyse the flow processes by using different pressure bound algorithms.
- Select and use the different turbulence models according to the type of flows.

TOTAL: 45 PERIODS
REFERENCES:

OBJECTIVES
1. To develop the students, understand the thermodynamic principles of general and engine combustion.
2. To acquire knowledge in chemical kinetics involved in general and engine combustion.
3. To study different types of flames, their structures and analyze the factors affecting on them.
4. To demonstrate the importance of engine heat release rate and heat transfer models for engine combustion analysis.
5. To acquire knowledge in experimental methods for combustion and heat transfer calculations to apply in engines analysis.

UNIT – I  INTRODUCTION TO COMBUSTION PROCESSES  9

UNIT – II  THERMODYNAMICS OF COMBUSTION  9
UNIT – III  NORMAL, ABNORMAL COMBUSTION IN SI ENGINES
Stages of combustion – Flame propagation — Flame Limits –Flame Extinction - Rate of pressure rise – Cycle to cycle variation – Abnormal combustion – Theories of detonation – Effect of engine operating variables on combustion – Example problems.

UNIT – IV  COMBUSTION AND HEAT TRANSFER IN IC ENGINES

UNIT – V  EXPERIMENTAL INVESTIGATION OF COMBUSTION AND HEAT TRANSFER IN IC ENGINES
Photographic studies of combustion processes – P-θ diagrams in SI and CI engines, Assembly – Temperature measurement in piston – cylinder liner – Cylinder head and engine valves.

OUTCOMES:
1. Upon completion the students summarize the thermodynamic principles of general and engine combustion.
2. They understand the principle of engine combustion and the various heat transfer models and measuring methods of engine heat transfer in detail
3. They will have comment over on different flames and their importance in combustion applications
4. They will understand thermodynamics of combustion, grasp the knowledge of normal, abnormal combustion and heat transfer in engines
5. They also understand and apply the experimental techniques in investigating the combustion and heat transfer processes in IC engines

CO – PO Mapping

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REFERENCES:
OBJECTIVES

- To acquire knowledge on availability of renewable fuels in the world and the technologies used for biofuel production
- To understand the challenges and difficulties involved in using alternative fuels in internal combustion engines
- To acquire complete knowledge on availability of possible alternate fuels and their properties to use as fuel in CI and SI engines
- To explore the possible methods of using all the renewable fuels in SI and CI engines and analyze the engines behavior with different fuels and methods
- To develop a complete understanding of changing the engine system, modifying the fuel for efficient use in engines

UNIT I

ALTERNATIVE FUELS, PROPERTIES AND PRODUCTION METHODS OF FUELS

Need for alternative fuels. World and Indian energy scenario on alternative fuels. Production technologies for biofuels for internal combustion engines- Pyrolysis, gasification, digestion.

UNIT II

ALCOHOLS


UNIT III

VEGETABLE OILS

Various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines. Role of Nano fluids, additives and cetane improvers for performance improvement of vegetable oils as fuel.

UNIT IV

HYDROGEN


UNIT V

BIOGAS, LPG AND NATURAL GAS

Production methods of Biogas, Natural gas and LPG. Properties studies. CO₂ and H₂S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines.

TOTAL 45 PERIODS

OUTCOMES

- Upon completion the course the students will have the complete knowledge on possible bio fuel production methods and their properties in detail.
- They will be able to apply their knowledge in making changes in engine design and fuel modification for the utilizing liquid alternative fuels effectively in the engines.
- They will be able to demonstrate the engines operation with new fuels and methods
- They further will innovate methods and design changes for optimal use of liquid alternative fuels in conventional engines
- They will be able to apply knowledge in using all the renewable gaseous fuels in IC engines with superior engine operation.
REFERENCES
5. Technical papers of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

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AM4013 HYDRAULIC AND PNEUMATIC SYSTEMS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basics of hydraulic and pneumatic systems
- To examine the working of hydraulic power drives
- To apply knowledge on fluid power elements
- To design hydraulic and pneumatic systems.
- To evaluate the concept of programming in PLC circuits.

UNIT I INTRODUCTION

UNIT II PNEUMATIC SYSTEMS
UNIT III HYDRAULIC SYSTEMS

UNIT IV SERVO AND PLC SYSTEMS
Electro pneumatics, ladder diagram for Basic Logic gates Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming. Comparison of PLC system over Relay Logic.

UNIT V AUTOMOTIVE APPLICATIONS
Hydraulic tipping mechanism, power steering, forklift hydraulic gear, hydro-pneumatic suspension, air brake, Fluid Coupling and Torque converter. Maintenance and trouble shooting. Design and analysis of a hydraulic /Pneumatic system. Case Study

TOTAL : 45 PERIODS

OUTCOMES:
- Understand the basics of hydraulic and pneumatic systems
- Examine the working of hydraulic power drives
- Apply knowledge on fluid power elements
- Design hydraulic and pneumatic systems.
- Evaluate the concept of programming in PLC circuits.

REFERENCES:
2. Werner Deppert and Kurt Stoll, “Pneumatic Controls : An introduction to principles”, Vogel-Druck Wurzburg, Germany, 1975

AM4014 IC ENGINE PROCESS MODELING

OBJECTIVES
1. To impart knowledge in modeling the Internal combustion engine processes and acquire knowledge in different types of engine models and their importance
2. To understand the calculation of heat of reaction, air fuel ratio and flame temperature for developing a thermodynamic engine model.
3. To acquire knowledge on the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
4. To understand the gas exchange process and develop models for the intake and exhaust processes.
5. To develop a complete theoretical engine model for the SI engine and differentiate the model from CI engine model.
UNIT I  INTRODUCTION TO SIMULATION  

UNIT II  STOICHIOMETRY AND ADIABATIC FLAME TEMPERATURE  
Reactive processes, Heat of reaction, measurement of URP, measurement of HRP. Introduction - combustion equation for hydrocarbon fuels. Calculation of minimum air, excess air and stoichiometric air required for combustion. Introduction, complete combustion in C-H-N-O systems, constant volume adiabatic combustion, constant pressure adiabatic combustion, calculation of adiabatic flame temperature, isentropic changes of state.

UNIT III  SI ENGINE SIMULATION  
SI Engine simulation with air as working medium, deviation between actual and ideal cycle. Fuel air cycle analysis - Temperature drop due to fuel vaporization, full throttle operation, work output and efficiency calculation, part-throttle operation, engine performance at part throttle, super charged operation. SI Engines simulation with progressive combustion. Models for mass burnt fraction.

UNIT IV  SI ENGINE SIMULATION WITH GAS EXCHANGE PROCESS  
Introduction, gas exchange process, Heat transfer process, friction calculations, comparison of simulated values, validation of the computer code, engine performance simulation, pressure crank angle diagram, brake power, brake thermal efficiency, effect of speed on performance and analysis of the data.

UNIT V  ENGINE SIMULATION FOR CI AND ADVANCED ENGINES  

TOTAL: 45 PERIODS

OUTCOMES
1. Students will understand the classifications and applications of engine cycle simulation model and grasp the major modeling and simulation methods and the influence of model parameters on engine performance.
2. They will be able to calculate the heat of reaction, fuel air ratio and flame temperature for developing a thermodynamic engine model.
3. They will acquire knowledge on the detailed concept of air standard, fuel air cycle, progressive and actual cycle simulation of SI engine.
4. Students will become familiar with the modeling of progressive combustion and gas exchange processes and ability to build up control-oriented simulation model of internal combustion engines.
5. They will get familiarized with the essential models of engine cycle simulation and theoretical knowledge to control the calculation accuracy and calculation efficiency of engine performance, combustion and emission.

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**AM4015 VEHICLE CONTROL SYSTEMS**

**OBJECTIVES**

- To understand the basics of control system used in automobiles
- To recognize the electronically controlled system used in driving mechanics.
- To understand the working principle of driver modelling and power train control systems.
- To identify the control system used in hybrid and electrical vehicles.
- To illustrate the need of automated transport systems

**UNIT I INTRODUCTION**

Components of chassis management system – role of various sensors and actuators pertaining to chassis system – construction – working principle of wheel speed sensor, steering position, tyre pressure, brake pressure, steering torque, fuel level, Engine and vehicle design data.

**UNIT II DRIVELINE CONTROL SYSTEM**


**UNIT III SAFETY AND SECURITY SYSTEM**

Airbags, seat belt tightening system, collision warning systems, child Lock, anti lock braking systems, Vision enhancement, road recognition system, Anti theft technologies, smart card system, number plate coding, central locking system.

**UNIT IV COMFORT SYSTEM**

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

**UNIT V INTELLIGENT TRANSPORTATION SYSTEM**

Traffic routing system - Automated highway systems - Lane warning system – Driver Information System, driver assistance systems - Data communication within the car, Driver conditioning warning - Route Guidance and Navigation Systems – vision enhancement system - In-Vehicle Computing –Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies

**TOTAL: 45 PERIODS**
OUTCOMES:
- Understand the basics of control system used in automobiles
- Recognize the electronically controlled system used in driving mechanics.
- Understand the working principle of driver modelling and power train control systems.
- Identify the control system used in hybrid and electrical vehicles.
- Illustrate the need of automated transport systems.

REFERENCES:

AM4016 VEHICLE MAINTENANCE AND DIAGNOSTICS

OBJECTIVES:
To import knowledge on
- To give knowledge on the importance of vehicle maintenance
- To impart knowledge on sub systems of engine and chassis and its maintenance
- To understand different transmission systems and its maintenance
- To understand vehicle body structure and its maintenance
- To understand the function of various electrical and electronic units and its maintenance

UNIT I MAINTENANCE RECORDS, BASIC TOOLS AND INSTRUMENTS

UNIT II POWER PLANT REPAIR AND OVERHAULING

UNIT III MAINTENANCE, REPAIR AND OVERHAULING OF THE CHASSIS
Maintenance, servicing and repair of clutch, gearbox, propeller shaft. Maintenance of front axle, rear axle, brakes, steering systems. Tyre maintenance.

UNIT IV MAINTENANCE AND REPAIR OF VEHICLE BODY
Body panel tools for repairing. Tinkering and painting. Minor and major repairs. Door lock and window glass actuating system maintenance.

UNIT V MAINTENANCE AND REPAIR OF ELECTRICAL AND ELECTRONIC SYSTEMS
Maintenance, testing and trouble shooting of battery, starter motor, dynamo, alternator, regulator, lighting system, horn and dash board instruments. Introduction to OBD.

TOTAL : 45 PERIODS
OUTCOMES:
Upon the completion of the course student can able to understand
- The importance of maintenance
- Various sub systems of vehicle and its maintenance Understand Transmission
- Functions of transmission and its maintenance
- The importance of vehicle body structure
- Basic functional principle of electrical and electronic gadgets in automobile and its maintenance

CO – PO Mapping

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REFERENCES:
3. Ernest Venk., Edward spicer, Automotive maintenance and trouble shooting, D.B.
4. Taraporevala Sons, Bombay, 1963

AM4017 INTELLIGENT TRANSPORT SYSTEMS  L  T  P  C  3 0 0 3

OBJECTIVES:
To import knowledge on
- To describe the digital map database module
- To describe the working of the positioning module.
- To describe the working of the direction module
- To describe the working of wireless communication module.
- To describe the working of autonomous location and navigation module.

UNIT I DIGITAL MAP DATABASE MODULE
UNIT II POSITIONING MODULE
Introduction-Dead Reckoning-Global Positioning System - Sensor fusion - Conventional map matching - Fuzzy logic Based Map matching - Other Map matching algorithms - Map aided Sensor calibration.

UNIT III DIRECTION MODULE
Shortest Path - Heuristic Search - Bidirectional Search - Hierarchical search - other algorithms - Guidance while En Route - Guidance while off Route - Guidance with dynamic information.

UNIT IV WIRELESS COMMUNICATION MODULE
Introduction - Communication Subsystem Attributes - Existing Communication Technologies - Communication Subsystem Integration.

UNIT V AUTONOMOUS LOCATION AND NAVIGATION

TOTAL : 45 PERIODS

OUTCOMES:
Upon the completion of the course student can able to understand
• the digital map database module
• the working of the positioning module
• the working of the direction module
• the working of wireless communication module.
• the working of autonomous location and navigation module

REFERENCES:

CO – PO Mapping

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OBJECTIVES:
To import knowledge on
- To understand the forces & moments influencing drag
- To solve exercises related to fuel economy & drag.
- To appraise upon the techniques of shape based optimization practiced in industry
- To identify the influence of rider position in motorcycle aerodynamics.
- To understand fundamentals of Experimental testing

UNIT I  SCOPE OF ROAD VEHICLE AERODYNAMICS  9

UNIT II  AIR RESISTANCE ON PASSENGER CARS  9

UNIT III  AERODYNAMIC DRAG ON COMMERCIAL VEHICLES  9

UNIT IV  MOTORCYCLE AERODYNAMICS  9

UNIT V  WIND TUNNELS, MEASUREMENT AND TEST TECHNIQUES  9

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course the students should be able to
1. Understand the forces & moments influencing drag.
2. Solve exercises related to fuel economy & drag.
3. Appraise upon the techniques of shape based optimization practiced in industry.
4. Identify the influence of rider position in motorcycle aerodynamics.
5. Expose to fundamentals of Experimental testing.

REFERENCES:
AM4019 PRODUCTION OF AUTOMOTIVE COMPONENTS

OBJECTIVES:
To import knowledge on
- To compare and analyse the different casting process
- To design various machining process according to the requirement
- Analysis of suitable process related to forming
- To differentiate the effect of powder metallurgy on selective components
- To impart knowledge on recent trends of automotive components

UNIT I CASTING

UNIT II MACHINING
Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston

UNIT III FORGING AND EXTRUSION PROCESS

UNIT IV POWDER METALLURGY AND PROCESSING OF PLASTICS
UNIT V RECENT TRENDS IN MANUFACTURING OF AUTO COMPONENTS


TOTAL: 45 PERIODS

OUTCOMES:
By the end of this course, students will be able to
- Identify the methods to manufacture the vehicle components
- Analyze the requirements of each component and material
- Differentiate between the casting and forming process
- Design the process for manufacturing vehicle components
- Understand the advanced techniques used for manufacturing Automobile components

REFERENCES
6. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
7. HMT handbook

AM4020 THERMAL MANAGEMENT OF HYBRID SYSTEMS

OBJECTIVES:
The course should enable the students:
- To understand the concepts of fluid mechanics and heat transfer
- To Design concepts for Heat Extraction in Motors
- To identify the thermal management of battery systems and power electronics
- To apply the concepts of thermal management in various automotive systems.

UNIT I REVIEW OF THERMODYNAMICS, FLUID MECHANICS, AND HEAT TRANSFER

First Law of Thermodynamics for open and closed systems; internal energy, enthalpy, and specific heat - Second Law of Thermodynamics for closed systems; Tds equations, Gibbs function - Fluid mechanics: laminar vs. turbulent flow, internal flow relationships, Navier Stokes equations - Heat transfer: simple conduction, convection, and radiation relationships; Nusselt number relationships for convective heat transfer; energy equation.

UNIT II THERMAL MANAGEMENT OF MOTORS

UNIT III THERMAL MANAGEMENT FOR BATTERIES
Thermal control in vehicular battery systems: battery performance degradation at low and high temperatures - Passive, active, liquid, air thermal control system configurations for HEV and EV applications - Battery Heat Transfer

UNIT IV THERMAL MANAGEMENT FOR POWER ELECTRONICS
Introduction to battery modeling: tracking current demand, voltage, and State of Charge as functions of time for given drive cycles - Development of thermodynamic relationships for cell heat generation - Lumped cell and pack models for transient temperature response to drive cycles - Model parametric study results

UNIT V THERMAL MANAGEMENT SYSTEMS
Overall energy balance to determine required flowrates - Determination of convection and friction coefficients for air and liquid systems in various geometric configurations: flow around cylinders, flow between plates, flow through channels - Development of a complete thermal system model and parametric study results - Temperature control and heat transfer using phase change materials - Thermal Management of Power Electronics.

TOTAL: 45 PERIODS

OUTCOMES:
The students should be able to:
- Understand the concepts of fluid mechanics and heat transfer
- Design concepts for Heat Extraction in Motors
- Identify the thermal management of battery systems and power electronics
- Apply the concepts of thermal management in various automotive systems.

REFERENCES:
UNIT I  FUNDAMENTALS  9
Terminology, design factors and concepts related to air conditioning system – Construction and Working principles of Thermostatic Expansion valve and Orifice tube based system- Heating system types -detailed study of HVAC components like compressor, evaporator, condenser, TXV, orifice tube, Receiver-drier, heater core etc. Location of air conditioning components in a vehicle.

UNIT II  REFRIGERANTS & AIR MANAGEMENT SYSTEMS  9
Refrigerants: Temperature and pressure relation, Properties of R-12 and R134a- refrigerant oil. Simple problems -Containers - Handling refrigerants - Tapping into the refrigerant container - Ozone Layer Depletion. Air management system: Air routing for manual, semi and automatic system- cases and ducts- Air distribution, control head and doors- Defrost system

UNIT III  AUTOMATIC CLIMATE CONTROL SYSTEM  9
Block diagram - types of Sensors and Actuators, - Control Logic Electrical wiring diagram of manual and automatic system - multiplexing between BCM and PCM- control of compressor clutch, blower motor etc- diagnostics tools and features.

UNIT IV  DESIGN OF AIR-CONDITIONING COMPONENTS  9
Modeling of Fixed and variable Displacement type compressor, evaporator modeling – heat transfer correlations for the fluids inside the evaporator, analysis of evaporator frosting-condenser modeling - improvement of refrigerant flow control method.

UNIT V  AIR CONDITIONING DIAGNOSIS AND SERVICES  9
AC system diagnosis based on temperature and pressure measurements, sight glass, sound etc. - refrigerant leak detection- Trouble shooting and Servicing of compressor, evaporator, condenser, heater core – HVAC equipment , recovery and charging. Air routing system service.

TOTAL: 45 PERIODS

OUTCOMES:
• Solve the simple problems related to psychrometry and refrigerant
• Understand the operation of the individual components of the A/System, sensors, actuators and electronic control
• Understand the range of techniques that can be used in diagnosing
• Identify faults which affect system performance
• Provide adequate knowledge in safe working practice, understanding the correct procedures for A/C service and repair

REFERENCES :
OBJECTIVES:
The course should enable the students:
- To introduce vehicle structural crashworthiness and crash testing
- To introduce pedestrian safety
- To get the knowledge in sensors provided in the vehicle to avoid the crash and to detect the obstacles around the vehicle.
- To understand the fundamentals of sensor data fusion as it relates to ADAS.
- To understand the concept of the connected vehicle and its role in ADAS and automated vehicles.

UNIT I CONCEPTS OF AUTOMOTIVE SAFETY

UNIT II PASSIVE SAFETY EQUIPMENTS AND CONVENIENCE SYSTEM
Seat belt, Seat belt tightener system and importance, collapsible steering column. Air bags and its activation. Designing aspects of automotive bumpers and materials for bumpers. Steering and mirror adjustment, central locking system, Tire pressure control system, rain sensor system, Automated wiper system.

UNIT III ACTIVE SAFETY
Antilock braking system, Stability Control. Adaptive cruise control, Lane Keep Assist System, Collision warning, avoidance system, Blind Spot Detection system, Driver alertness detection System. ADAS

UNIT IV VEHICLE INTEGRATION AND NAVIGATION SYSTEM

UNIT V AUTONOMOUS VEHICLE

TOTAL: 45 PERIODS

OUTCOMES:
The students should be able to:
- Know about the design of the bumper for safety.
- Know about the concept of crumble zone, and also the effect of acceleration and deceleration of the vehicle in the compartment of the vehicle.
- Know the various types of safety aspects such as active and passive safety, the active safety components and the working passive safety components such as air bags, seatbelts
- Understand the fundamentals of sensor data fusion as it relates to ADAS.
- Understand the concept of the connected vehicle and its role in ADAS and automated vehicles.
REFERENCES:
1. ARAI Safety standards

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AM4023 INDUSTRY 4.0 AND IoT

OBJECTIVES:
The course should enable the students:
- To explore how Industry 4.0 will change the current manufacturing technologies and processes by digitizing the value chain.
- To Understand the drivers and enablers of Industry 4.0.
- To Learn about various IoT-related protocols
- To Build simple IoT Systems using Arduino and Raspberry Pi..

UNIT I INTRODUCTION TO INDUSTRY 4.0

UNIT II INTRODUCTION TO IOT
Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.
UNIT III ELEMENTS OF IOT
Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API’s (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP

UNIT IV IOT APPLICATION DEVELOPMENT

UNIT V IOT APPLICATION IN AUTOMOBILES
Fleet Management: Real-time location monitoring of the fleet, Weight/Volume tracking of cargo that the fleet is carrying, Trucks’ performance statistics like fuel and mileage, Tracking traffic conditions on the road, Route management, Time and Driver management, connected cars: Vehicle to vehicle, Vehicle to infrastructure, Vehicle to pedestrians, Vehicle to network, Automotive Maintenance System: Autonomous vehicle; In-vehicle Infotainment and Telematics:

TOTAL: 45 PERIODS

OUTCOMES:
The students should be able to:
- Explore how Industry 4.0 will change the current manufacturing technologies and processes by digitizing the value chain.
- Understand the drivers and enablers of Industry 4.0.
- Learn about various IoT-related protocols
- Build simple IoT Systems using Arduino and Raspberry Pi

REFERENCES:
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs, 2017
### AUDIT COURSES

#### AX4091  ENGLISH FOR RESEARCH PAPER WRITING  L T P C

#### 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

#### 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
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
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

UNIT III  DISASTER PRONE AREAS IN INDIA
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
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
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

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

TOTAL : 30 PERIODS
REFERENCES

AX4093       CONSTITUTION OF INDIA       L T P C
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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 Revolution in 1917 and 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

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

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.

OUTCOMES

TOTAL: 30 PERIODS

61
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.
1. சிறுபொணொற்றுப்பகட
   - பாரி மேல்வள்ளைத் தின்நங்கான் தென்ன முப்பிள்ளையை பார்வையின
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2. குறிக்கறன
   - அதிராயக்குறியின புலகான சின்பப
3. சிறுவனம் (617, 618)
   - தேசம் சிவன சிற்சின்ன
4. இயற்றாசாரையம் தியேவின் வெள்ள வரலேற்ற
5. புராணத்துக்கு
   - தியேவின் வெள்ளங்கானன
6. அகமத்து (4) - வெள்ள
   நாகாத்து (11) - வெள்ள
   கலிகுத்து (11) - பார்வேன், போன
   நாகாத்து 50 (27) - போனா
   குறிப்பொருள் குறிப்பிட்டிட

UNIT V

1. நவீன தமிழ் நெளியீட்டு
   - குறிப்பொருள், சிற்சின்ன
   - குறிப்பொருள் புள்ளி, சிற்சின்ன
   - குறிப்பொருள் சிள்சின்ன
   - குறிப்பொருள் தன்னித்தீர்க்கு
   - போனா, சிற்சின்ன
   - குறிப்பொருளை விளக்கு
2. நார்க்கை சிற்கோண பொவூர்வெத்த குறிப்பிட்டிட
3. குறிப்பொருள் நெளியீட்டு
4. பொருளான தியேவின் தியேவின் சிற்கோண பொவூர்வெத்துத்தீர்க்க
5. குறிப்பொருள் குறிப்பிட்டிட
6. புடைப்புக்கு தியேவின் குறிப்பிட்டிட
7. குறிப்பொருள் விளக்கம் குறிப்பிட்டிட

TOTAL: 30 PERIODS

தமிழ் தொகுப்பு வைக்கிளியங்கள்: / புத்தாண்டிகள்

1. தமிழ் தியேவின் குறிப்பிட்டிட
   - தமிழ் விளக்கான் தமிழ் தொகுப்பு வைக்கிளியங்கள் (Tamil Virtual University)
     - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியங்கள் (Tamil Wikipedia)
     - https://ta.wikipedia.org
3. தமிழ் தவளையங்கள்
4. தமிழ் பலகல்களும் தஞ்சாவுர்
5. தமிழ் தவளையங்கள்
6. ஆறிவியல் களஞ்சியம்
   - தமிழ் பல்கலைக்கழகம், தஞ்சாவுர்

- தமிழ் எண்ணறத்தில் கடற்ப (thamilvalarchithurai.com)
OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I  CONTEXT FOR IWRM

- Water as a global issue: key challenges
- Definition of IWRM within the broader context of development
- Key elements of IWRM - Principles
- Paradigm shift in water management
- Complexity of the IWRM process
- UN World Water Assessment - SDGs.

UNIT II  WATER ECONOMICS

- Economic view of water issues: economic characteristics of water good and services
- Non-market monetary valuation methods
- Water economic instruments
- Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III  LEGAL AND REGULATORY SETTINGS

- Basic notion of law and governance: principles of international and national law in the area of water management
- Understanding UN law on non-navigable uses of international water courses
- International law for groundwater management
- World Water Forums
- Global Water Partnerships
- Development of IWRM in line with legal and regulatory framework.

UNIT IV  WATER AND HEALTH WITHIN THE IWRM CONTEXT

- Links between water and health: options to include water management interventions for health
- Health protection and promotion in the context of IWRM
- Global burden of Diseases
- Health impact assessment of water resources development projects
- Case studies.

UNIT V  AGRICULTURE IN THE CONCEPT OF IWRM

- Water for food production: ‘blue’ versus ‘green’ water debate
- Water footprint
- Virtual water trade for achieving global water and food security
- Irrigation efficiencies, irrigation methods
- Current water pricing policy
- Scope to relook pricing.

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

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<th>Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.</th>
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<tr>
<td>CO2</td>
<td>Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.</td>
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<td>CO3</td>
<td>Apply law and governance in the context of IWRM.</td>
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<td>CO4</td>
<td>Discuss the linkages between water-health; develop a HIA framework.</td>
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<td>CO5</td>
<td>Analyse how the virtual water concept pave way to alternate policy options.</td>
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REFERENCES:

CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT

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<td>PO12 Life Long Learning</td>
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<tr>
<td>PSO1 Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
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<tr>
<td>PSO2 Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability</td>
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<td>PSO3 Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water resources management</td>
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</table>
OBJECTIVES:

- Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario.

UNIT I

FUNDAMENTALS WASH

Meanings and Definition: Safe Water - Health, Nexus: Water - Sanitation - Health and Hygiene – Equity issues - Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH.

UNIT II

MANAGERIAL IMPLICATIONS AND IMPACT


UNIT III

CHALLENGES IN MANAGEMENT AND DEVELOPMENT


UNIT IV

GOVERNANCE

Public health - Community Health Assessment and Improvement Planning (CHA/CHIP) - Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis – Institutional Intervention - Public Private Partnership - Policy Directives - Social Insurance - Political Will vs Participatory Governance -

UNIT V

INITIATIVES

Management vs Development - Accelerating Development - Development Indicators - Inclusive Development - Global and Local - Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

| CO1  | Capture to fundamental concepts and terms which are to be applied and understood all through the study. |
| CO2  | Comprehend the various factors affecting water sanitation and health through the lens of third world scenario. |
| CO3  | Critically analyse and articulate the underlying common challenges in water, sanitation and health. |
| CO4  | Acquire knowledge on the attributes of governance and its say on water sanitation and health. |
| CO5  | Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects. |
REFERENCES


CO PO MAPPING : WATER, SANITATION AND HEALTH

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<td>PSO1</td>
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<td>PSO3</td>
<td>Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.</td>
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OBJECTIVES:
- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES

UNIT II PRINCIPLES AND FRAME WORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS

UNIT V ASSESSING PROGRESS AND WAY FORWARD
Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP- Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability -
Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

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<tr>
<th>CO</th>
<th>Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises.</th>
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<tr>
<td>CO2</td>
<td>Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals</td>
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<td>CO3</td>
<td>Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption</td>
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<td>CO4</td>
<td>Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.</td>
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<td>CO5</td>
<td>Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.</td>
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REFERENCES:

CO – PO Mapping – Principles of Sustainable Development

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<td>PSO1 Knowledge of Environmental</td>
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OBJECTIVES:
- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Understand various impact identification methodologies, prediction techniques and model of impacts on various environments</td>
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<td>CO3</td>
<td>Understand relationship between social impacts and change in community due to development activities and rehabilitation methods</td>
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<td>CO4</td>
<td>Document the EIA findings and prepare environmental management and monitoring plan</td>
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<td>CO5</td>
<td>Identify, predict and assess impacts of similar projects based on case studies</td>
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</tbody>
</table>

REFERENCES:
1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

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<tr>
<th>CO – PO Mapping- ENVIRONMENTAL IMPACT ASSESSMENT</th>
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<td>PO12 Life Long Learning</td>
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<tr>
<td>PSO1 Knowledge of Environmental discipline</td>
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<tr>
<td>PSO2 Environmental Performance Evaluation and coordination</td>
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<td>PSO3 Conceptualization of Environmental Engineering Systems</td>
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OIC431 BLOCKCHAIN TECHNOLOGIES

COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.
UNIT I  INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN  9
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II  BITCOIN AND CRYPTOCURRENCY  9

UNIT III  INTRODUCTION TO ETHEREUM  9
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.

UNIT-IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  10

UNIT V  BLOCKCHAIN APPLICATIONS  8
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:

CO-PO Mapping

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COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Build and train RNNs, work with NLP and Word Embeddings.
- The internal structure of LSTM and GRU and the differences between them.
- The Auto Encoders for Image Processing.

UNIT I DEEP LEARNING CONCEPTS 6


UNIT II NEURAL NETWORKS 9


UNIT III CONVOLUTIONAL NEURAL NETWORK 10


UNIT VI NATURAL LANGUAGE PROCESSING USING RNN 10


UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10


COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45 PERIODS
OBA431  SUSTAINABLE MANAGEMENT  LT P C  3 0 0 3

COURSE OBJECTIVES:
- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I  MANAGEMENT OF SUSTAINABILITY  9
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II  CORPORATE SUSTAINABILITY AND RESPONSIBILITY  9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III  SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES  9
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV  SUSTAINABILITY AND INNOVATION  9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V  SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

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OBA432 MICRO AND SMALL BUSINESS MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES
- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY
Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.
UNIT IV  FINANCING SMALL BUSINESS  9
Main sources of entrepreneurial capital; Nature of "bootstrap" financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin - Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V  VALUING SMALL BUSINESS AND CRISIS MANAGEMENT  9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

MAPPING OF POs AND COs

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OBA433  INTELLECTUAL PROPERTY RIGHTS  L T P C  3 0 0 3

COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.
UNIT I: INTRODUCTION
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II: PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III: STATUTES

UNIT IV: STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V: MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.

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COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations.

TOTAL: 45 PERIODS

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ET4251  IoT FOR SMART SYSTEMS  L T P C  3 0 0 3

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I  INTRODUCTION TO INTERNET OF THINGS  9
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II  IOT ARCHITECTURE  9

UNIT III  PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT  9
PROTOCOLS:
NFC, SCADA and RFID, Zigbee, MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe, GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV  IOT PROCESSORS  9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT : Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

UNIT V  CASE STUDIES  9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

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REFERENCES:
COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1-Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction. Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1: Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.
## REFERENCES:


## OBJECTIVES:

To impart knowledge on:
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

## UNIT I
### INTRODUCTION
Classification of energy sources – CO2 Emission - Features of Renewable energy - Renewable energy scenario in India - Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

## UNIT II
### SOLAR PHOTOVOLTAICS

## UNIT III
### PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.
UNIT IV  WIND ENERGY CONVERSION SYSTEMS  9

UNIT V  OTHER RENEWABLE ENERGY SOURCES  9
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

OUTCOMES:
After completion of this course, the student will be able to:
CO1: Demonstrate the need for renewable energy sources.
CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources.

REFERENCES:

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COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications.
- To get familiarized with the communication networks for Smart Grid applications.

UNIT I  INTRODUCTION TO SMART GRID

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II  SMART GRID TECHNOLOGIES

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III  SMART METERS AND ADVANCED METERING INFRASTRUCTURE

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID


UNIT V  HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS

Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

COURSE OUTCOME:

Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications.
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CP4391 SECURITY PRACTICES L T P C
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COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY

UNIT II NETWORK SECURITY

UNIT III SECURITY MANAGEMENT

UNIT IV CYBER SECURITY AND CLOUD SECURITY
practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

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CO-PO Mapping

87
COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE

UNIT II CLOUD PLATFORM ARCHITECTURE

UNIT III AWS CLOUD PLATFORM - IAAS

UNIT IV PAAS CLOUD PLATFORM

UNIT V PROGRAMMING MODEL
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

COURSE OBJECTIVES:
- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I
UX LIFECYCLE TEMPLATE

UNIT II
CONTEXTUAL INQUIRY
UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

UNIT IV UX GOALS, METRICS, AND TARGETS 8

UNIT V ANALYSING USER EXPERIENCE 10

SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017
COURSE OBJECTIVES:
- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA
Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS

Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.
UNIT IV MULTIMEDIA SYSTEMS


Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS


Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:
COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I  INTRODUCTION TO BIG DATA

UNIT II  SEARCH METHODS AND VISUALIZATION

UNIT III  MINING DATA STREAMS

UNIT IV  FRAMEWORKS
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study: Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V  R LANGUAGE

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL: 45 PERIODS
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UNIT V  IoT AND CLOUD  9

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073  MEDICAL ROBOTICS  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I  INTRODUCTION TO ROBOTICS  9
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II  MANIPULATORS & BASIC KINEMATICS  9
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III  SURGICAL ROBOTS  9
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study
UNIT IV REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

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CO-PO Mapping
COURSE OBJECTIVES:
- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT - I  INTRODUCTION TO EMBEDDED C PROGRAMMING  9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II  AVR MICROCONTROLLER  9
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III  HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS  9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT - IV  VISION SYSTEM  9

UNIT – V  HOME AUTOMATION  9
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor -Proximity Garage Door Opener - Vision Based Authentic Entry System

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

TOTAL: 45 PERIODS

REFERENCES:

**CO-PO Mapping**

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**CX4016 ENVIRONMENTAL SUSTAINABILITY**

**UNIT I** INTRODUCTION 9
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

**UNIT II** CONCEPT OF SUSTAINABILITY 9
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

**UNIT III** SIGNIFICANCE OF BIODIVERSITY 9
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

**UNIT IV** POLLUTION IMPACTS 9
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

**UNIT V** ENVIRONMENTAL ECONOMICS 9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

**REFERENCES**

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<th>TX4092</th>
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**UNIT I** REINFORCEMENTS
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

**UNIT II** MATRICES
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

**UNIT III** COMPOSITE MANUFACTURING
Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

**UNIT IV** TESTING
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

**UNIT V** MECHANICS
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical lamination theory, failure theories and prediction of inter laminar stresses using at ware

**TOTAL:** 45 PERIODS

**REFERENCES**

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**UNIT I** BASICS OF NANOCOMPOSITES
UNIT II METAL BASED NANOCOMPOSITES
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III POLYMER BASED NANOCOMPOSITES
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V NANOCOMPOSITE TECHNOLOGY

TOTAL : 45 PERIODS

REFERENCES:
5. The search for novel, superhard materials- Stan Vepřej (Review Article) JVST A, 1999

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP L T P C 3 0 0 3

UNIT I IPR
UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES


UNIT III BIOSAFETY


UNIT IV GENETICALLY MODIFIED ORGANISMS

Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT


REFERENCES
