

# MAULANA AZAD NATIONAL URDU UNIVERSITY

(A Central University established by an Act of Parliament in 1998)

Accredited 'A' Grade by NAAC

Gachibowli, Hyderabad - 500 032, T.S.

## AICTE Model Curriculum with effect from 2022-23 for MANUU Polytechnics



## General Course Structure & Credit Distribution

# Diploma in Automobile Engineering

**Definition of Credit:**

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit
2 Hours Practical (P) per week	1 credit

**A. Program Credits:**

The total number of credits proposed for the three-year Diploma program in Engineering & Technology is 120.

**B. Structure of Diploma Engineering Program:**

The structure of Diploma Engineering program shall have essentially the following categories of courses with the breakup of credits as given:

Sr. No.	Category	Suggested Breakup of Credits
1.	Humanities & Social Sciences courses	7
2.	Basic Science courses	18
3.	Engineering Science courses	16
4.	Program Core courses (Branch specific)	46
5.	Program Elective courses (Branch specific)	12
6.	Open Elective courses (from other technical and /or emerging subjects)	9
7.	Project work, seminar and internship in industry or elsewhere	12
8.	Audit Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge etc.]	(non-credit)
	<b>Total</b>	<b>120</b>

**C. Course code and definition:**

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
HS	Humanities & Social Sciences Courses
BS	Basic Science Courses
ES	Engineering Science Courses
PC	Program Core Courses
PE	Program Elective Courses
OE	Open Elective Courses
AU	Audit Courses
SI	Summer Internship
PR	Project
SE	Seminar

**D. Course level codingscheme:**

As per the CBCS Rules and Regulations of Examination Branch of MANUU.

**E. Category-wise Courses****HUMANITIES & SOCIAL SCIENCES COURSES [HS]****Note:**

(i) Number of Humanities &amp; Social Sciences Courses: 4

(ii) Credits: 7

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.		Communication Skills in English	2	0	0	I	2
2.		Sports and Yoga	0	0	2	I	1
3.		Communication Skills in English Lab	0	0	2	I	1
4.		Entrepreneurship and Start-ups	3	0	0	VI	3
<b>Total Credits</b>							<b>7</b>

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**BASIC SCIENCES COURSE [BS]****Note:**

(i) Number of Basic Sciences Courses: 8

(ii) Credits: 18

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.		Mathematics-I	2	1	0	I	3
2.		Applied Physics-I	2	1	0	I	3
3.		Applied Chemistry	2	1	0	I	3
4.		Applied Physics-I Lab	0	0	2	I	1
5.		Applied Chemistry Lab	0	0	2	I	1
6.		Mathematics-II	3	0	0	II	3
7.		Applied Physics-II	2	1	0	II	3
8.		Applied Physics-II Lab	0	0	2	II	1
<b>Total Credits</b>							<b>18</b>

### ENGINEERING SCIENCE COURSES [ES]

**Note:**

- (i) Number of Engineering Sciences Courses: 8
- (ii) Credits: 16

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.		Engineering Graphics	0	0	3	I	1.5
2.		Engineering Workshop Practice	0	0	3	I	1.5
3.		Introduction to IT Systems	2	1	0	II	3
4.		Fundamentals of Electrical & Electronics Engineering	2	1	0	II	3
5.		Engineering Mechanics	2	1	0	II	3
6.		Introduction to IT Systems Lab	0	0	4	II	2
7.		Fundamentals of Electrical & Electronics Engineering Lab	0	0	2	II	1
8.		Engineering Mechanics Lab	0	0	2	II	1
<b>Total Credits</b>							<b>16</b>

### PROGRAM CORE COURSES [PC]

**Note:**

- (i) Number of Program Core Courses: 20 to 30 (including lab courses)
- (ii) Credits: 46**
- (iii) Number of contact hours per week of a subject may vary as per subject contents without affecting the subject credits.

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1							
.							
.							
n							
<b>Total Credits</b>							<b>46</b>

### PROGRAM ELECTIVE COURSES [PE]

**Note:**

- (i) Number of Program Elective Courses: 4 to 6  
(minimum ten Branch Specific courses to be specified for the students to choose from)
- (ii) Credits: **12**

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1							
.							
.							
n							
<b>Total Credits</b>							<b>12</b>

### OPEN ELECTIVE COURSES [OE]

**Note:**

- (i) Number of Open Elective Courses: 3 to 4 (minimum ten courses to be specified out of the suggestive list of open elective courses given as Appendix III)
- (ii) Credits: **9**
- (iii) The Open Elective Courses to be offered preferably in III year (one course may be offered in V Semester and two courses in VI Semester)
- (iv) The students can opt only for those open elective courses that are offered by other than their respective departments

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1							
.							
.							
n							
<b>Total Credits</b>							<b>9</b>

**PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE**

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.		Summer Internship – I (3-4 weeks) after II <sup>nd</sup> Sem					2
2.		Summer Internship – II (4-6 weeks) after IV <sup>th</sup> Sem					3
3.		Minor Project	0	0	4	IV	2
4.		Major Project	0	0	2	V	4
5.			0	0	6	VI	
6.		Seminar	1	0	0	VI	1
<b>Total Credits</b>							<b>12</b>

**Note:**

- Summer Internship – I should be undertaken in an industry/Govt. or Pvt. Certified Agencies which are in social sector/ Govt. Skill Centres/Institutes/Schemes.
- Summer Internship – II should be undertaken in an industry only
- Seminar should be based on real/ live problems of the Industry/Govt./NGO/ MSME/Rural Sector or an innovative idea having the potential of a Startup

**AUDIT COURSES [AU]**

**Note:** These are mandatory non-credit courses.

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.		Environmental Science	2	0	0	II	0
2.		Essence of Indian Knowledge and Tradition	2	0	0	IV	0
3.		Indian Constitution	2	0	0	VI	0
<b>Total Credits</b>							<b>0</b>

**DESCRIPTION OF BRANCH CODES**

Sr. No.	Branch	Code
1.	Civil Engineering	CE
2.	Computer Engineering	CO
3.	Electronics and Communication Engineering	EC
4.	Electrical Engineering	EE
5.	Mechanical Engineering	ME
6.	Production Engineering	PE
7.	Information Technology	IT
8.	Chemical Engineering	CH

## INDUCTION PROGRAM

Please refer Appendix IV for guidelines.

The Essence and Details of Induction program can also be understood from the ‘Detailed Guide on Student Induction program’, as available on AICTE Portal, although that is for UG students of Engineering & Technology

(Link: <https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf>).

Induction program (mandatory)	Two-week duration
Induction program for students to be offered right at the start of the first year.	<ul style="list-style-type: none"> <li>• Physical activity</li> <li>• Creative Arts</li> <li>• Universal Human Values</li> <li>• Literary</li> <li>• Proficiency Modules</li> <li>• Lectures by Eminent People</li> <li>• Visits to local Areas</li> <li>• Familiarization to Dept./Branch &amp; Innovations</li> </ul>

### F. Mandatory Visits/Workshop/Expert Lectures:

- a. It is mandatory to arrange one industrial visit every semester for the students of each branch.
- b. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.
- c. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry

### G. Evaluation Scheme:

- a) **For Theory Courses:** As per the CBCS Rules and Regulations of Examination Branch of MANUU.
- b) **For Practical Courses:** As per the CBCS Rules and Regulations of Examination Branch of MANUU.
- c) **For Summer Internship / Projects / Seminar etc.**

Evaluation is based on work done, quality of report, performance in viva-voce and presentation by the student in front of Internship & project review committees consist of HoD, Principal Nominated Member and Concerned Faculty.

**Semester I –Pool:2**  
**(Common to CSE, IT, EEE & AE)**  
**Curriculum Structure**

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Basic Science		Mathematics-I	2	1	0	3	<b>3</b>
2	Basic Science		Applied Physics-I	2	1	0	3	<b>3</b>
3	Engineering Science		Engineering Mechanics	2	1	0	3	<b>3</b>
4	Humanities & Social Science		Communication Skills in English	2	0	0	2	<b>2</b>
5	Engineering Science		Fundamentals of Electrical & Electronics Engineering	2	1	0	3	<b>3</b>
6	Humanities & Social Science		Communication Skills in English Lab	0	0	2	2	<b>1</b>
7	Engineering Science		Engineering Workshop Practice	0	0	3	3	<b>2</b>
8	Basic Science		Applied Physics-I Lab	0	0	2	2	<b>1</b>
9	Engineering Science		Engineering Mechanics Lab	0	0	2	2	<b>1</b>
10	Engineering Science		Fundamentals of Electrical & Electronics Engineering Lab	0	0	3	3	<b>2</b>
11	Audit		Environmental Science	2	0	0	2	<b>0</b>
<b>Total Credits</b>								<b>21</b>



**Semester II –Pool:1**  
**(Common to CSE, IT, EEE & AE)**  
**Curriculum Structure**

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Basic Science		Mathematics-II	2	1	0	3	<b>3</b>
2	Basic Science		Applied Physics-II	2	1	0	3	<b>3</b>
3	Engineering Science		Introduction to IT Systems	2	1	0	3	<b>3</b>
4	Engineering Science		Engineering Graphics	0	0	2	2	<b>1</b>
5	Basic Science		Applied Chemistry	2	1	0	3	<b>3</b>
6	Basic Science		Applied Physics-II Lab	0	0	2	2	<b>1</b>
7	Engineering Science		Introduction to IT Systems Lab	0	0	4	4	<b>2</b>
8	Basic Science		Applied Chemistry Lab	0	0	2	2	<b>1</b>
9	Humanities & Social Science		Sports and Yoga	0	0	2	2	<b>1</b>
<b>Total Credits</b>								<b>18</b>

## Mathematics- I

### Course

#### Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of Trigonometry, Differential Calculus and Basic elements of algebra.

#### Course Outcomes:

By the end of the course, the students are expected to learn

- (i) The students are expected to acquire necessary background in Trigonometry to appreciate the importance of the geometric study as well as for the calculation and the mathematical analysis.
- (ii) The ability to find the effects of changing conditions on a system.
- (iii) Complex numbers enter in to studies of physical phenomena in ways that most people cannot imagine.
- (iv) The partial fraction decomposition lies in the fact that it provides an algorithm for computing the anti derivative of a rational function.

#### Course Content:

##### UNIT-I: Trigonometry

Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof ), Sum, difference formulae and their applications (without proof ). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of sin x, cos x, tan x and  $e^x$ .

##### UNIT-II: Differential Calculus

$$\lim_{x \rightarrow 0} \frac{\sin x}{x}, \lim_{x \rightarrow a} \left( \frac{a^x - 1}{x} \right)$$

Definition of function; Concept of limits. Four standard limits

and  $\lim_{x \rightarrow a} (1+x)^{\frac{1}{x}}$  Differentiation by definition of  $x^n, \sin x, \cos x, \tan x, e^x$  and  $\log_a x$ .

Differentiation of sum, product and quotient of functions. Differentiation of function of a function. Differentiation of trigonometric and inverse trigonometric functions, Logarithmic differentiation, Exponential functions.

##### UNIT - III: Algebra

**Complex Numbers:** Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number Addition, Subtraction, Multiplication and Division of a complex number. De-moivre's theorem, its application.

**UNIT - IV: Partial fractions:** Definition of polynomial fraction proper & improper fractions and definition of partial fractions. To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors. To resolve improper fraction into partial fraction.

**Permutations and Combinations:** Value of  ${}^n P_r$  and  ${}^n C_r$ .

**Binomial theorem:** Binomial theorem (without proof ) for positive integral index (expansion and general form); binomial theorem for any index (expansion without proof ) first and second binomial approximation with applications to engineering problems

**Text Books:**

1. Text book of Intermediate Mathematics-I & II by Telugu Academy.
2. A Text book of Engineering Mathematics –I , II by Radiant Publication.

# APPLIED PHYSICS-I

## Course Objectives:

Applied Physics includes the study of a large number of diverse topics all related to materials/things that exist in the world around us. It aims to give an understanding of this world both by observation and by prediction of the way in which such objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

## Learning Outcome:

After undergoing this subject, the student will be able to:

- Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy by minimizing different types of errors.
- Represent physical quantities as scalar and vectors and solve real life relevant problems.
- Analyse type of motions and apply the formulation to understand banking of roads/railway tracks and conservation of momentum principle to describe rocket propulsion, recoil of gun etc.
- Define scientific work, energy and power and their units. Derive relationships for work, energy and power and solve related problems.
- Describe forms of friction and methods to minimize friction between different surfaces.

## Course Content:

### Unit 1: Physical world, Units, Dimensions and Vectors

Physics – scope and nature– physics in relation to technology, Physical quantities, Fundamental physical quantities, Derived physical quantities with examples, units, Fundamental units, Derived Units. State S.I. Units of various physical quantities with symbols, Rules for writing SI units. Dimensions of physical quantity, dimensional formulae and Dimensional Equations, Statement of principle of Homogeneity of Dimensions, State the applications of Dimensional Analysis, problems solving.

Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller

### Unit 2: Force, Motion, Work, Power and Energy

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications. Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, Centripetal and Centrifugal forces with live examples,

Define the terms work, power, energy and State their SI units, Define potential Energy and Kinetic Energy give examples and derive their expression. State and explain the law of conservation of Energy, verify in the case of freely falling body. Define simple harmonic motion and give examples, State the conditions of S.H.M, Define simple pendulum and second's pendulum, derive an expression for time period of simple pendulum

### Unit 3: Properties of Matter

Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, , applications of surface tension, effect of temperature and impurity on surface tension. Capillarity and states examples, Experimental determination of surface tension based on capillarity tube method. Viscosity and coefficient of viscosity: and effect of temperature on viscosity.

#### **Unit 4: Heat and Thermometry**

Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses. Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them.

## Applied Physics-I Lab

### Course Objectives

Study of Applied Physics aims to give an understanding of physical world by observations and predictions. Concrete use of physical principles and analysis in various fields of engineering and technology is very prominent. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get necessary confidence in handling equipment and thus learn various skills in measurement.

### Learning Outcome:

After undergoing this lab work, the student will be able to:

- Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer etc.) for determining dimensions of physical quantities and make measurements with accuracy and precision.
- Differentiate various shapes and determine dimensions of plane, curved and regular surfaces/bodies.
- Apply and Verify laws of forces and determine resultant force acting on a body.
- Appreciate role of friction and measure coefficient of friction between different surfaces.
- Describe and verify Hooke's law and determine force constant of spring body.
- Identify various forms of energy, energy transformations and verify law of conservation of energy.
- Understand rotational motion and determine M.I. of a rotating body (flywheel)
- Understand Stoke's law for viscous liquids and determine viscosity of a given liquid.
- Understand how materials expand on heating and determine linear expansion coefficient for a given material rod.
- Understand working and use Fortin's barometers for determining pressure at a place.
- Understand use of thermometers to measure temperature under different conditions and different scales of temperature measurements.

### List of Practical's

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To determine force constant of a spring using Hooke's Law.
6. To find the viscosity of a given liquid (Glycerin) by Stoke's law
7. To determine atmospheric pressure at a place using Quill Tube Method
8. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.
9. To verify law of conservation of mechanical energy (PE to KE).
10. To find the surface Tension of a given liquid by capillary Rise Method.

## Applied Chemistry

### Course Objectives:

There are numerous number materials are used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. On successful completion of this course content will enable technicians to understand, ascertain and analyze and properties of natural raw materials require for producing economical and ecofriendly finished products.

- Solve various engineering problems applying the basic knowledge of atomic structure and chemical bonding.
- Use relevant water treatment method to solve domestic and industrial problems.
- Solve the engineering problems using knowledge of engineering materials and properties.
- Use relevant fuel and lubricants for domestic and industrial applications
- Solve the engineering problems using concept of Electrochemistry and corrosion.

### Learning Outcomes

At the end of the course student will be able to

1. Understand the classification and general properties of engineering materials such as metal, alloys, glasses, cement, refractory and composite materials using knowledge of chemical bonding.
2. Understand and assess the suitability of water source for domestic and industrial application, effluents and minimize water pollution.
3. Qualitatively analyze the engineering materials and understand their properties and applications.
4. Choose fuel and lubricants suitable for economical industrial processing to obtain eco-friendly finished products.
5. a) Ascertain construction, mechanism efficiency of electrochemical cells, solar cell fuel cells.  
b) Understand corrosion and develop economical prevention techniques.

### Course Content:

#### **Unit 1: Atomic Structure, Chemical Bonding and Solutions**

Bohr's theory (expression of energy and radius to be omitted), Quantum numbers orbital concept. Shapes of s, p and d orbitals, Paul's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration.

Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example), covalent bond, co-ordination bond in  $\text{NH}_4^+$ .

Solution – idea of solute, solvent and solution, methods to express the concentration of solution- molarity ( $M$ =mole per liter), ppm.

#### **Unit 2: Water, Chemistry of Fuels and Lubricants**

Graphical presentation of water distribution on Earth (pie or bar diagram). Classification of soft and hard water based on soap test, salts causing water hardness, unit of hardness and simple numerical on water hardness.

Cause of poor lathering of soap in hard water, problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion etc). Water softening techniques – soda lime process, zeolite process and ion exchange process.

Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization.

Chemistry of Fuels and Lubricants:

Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula.

Chemical composition, calorific values and applications of LPG, CNG, water gas, coal gas, producer gas and biogas.

Lubrication – function and characteristic properties of good lubricant, classification with examples. physical properties (viscosity and viscosity index, oiliness, flash and fire point, cloud and pour point only) and chemical properties (coke number, total acid number saponification value) of lubricants.

### **Unit 3: Engineering Materials**

Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy – brief account of general principles of metallurgy. Extraction of iron from haematite ore using blast furnace. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

Portland cement and hardening, Glasses Refractory and Composite materials.

Polymers – monomer, homo and co polymers, simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using PVC, PS, PTFE, nylon – 6, nylon – 66, Bakelite only), rubber and vulcanization of rubber.

### **Unit 4: Electrochemistry**

Electronic concept of oxidation, reduction and redox reactions.

Definition of terms: electrolytes, non-electrolytes with suitable examples, Faraday's laws of

electrolysis and simple numerical problems. Industrial Application of Electrolysis –

- Electrometallurgy
- Electroplating
- Electrolytic refining.

Application of redox reactions in electrochemical cells –

- Primary cells – dry cell,
- Secondary cell – commercially used lead storage battery, fuel and Solar cells.

Introduction to Corrosion of metals –

- definition, types of corrosion (chemical and electrochemical), H<sub>2</sub> liberation and O<sub>2</sub> absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.

Internal corrosion preventive measures –

- Purification, alloying and heat treatment and

External corrosion preventive measures: a) metal (anodic, cathodic) coatings, b) organic inhibitors.

Text Books:

- 1) Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
- 2) Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.



## Applied Chemistry Lab

### Course Objectives:

There are numerous numbers of materials used in fabricating and manufacturing devices for the comfort of life. The selection, characterization and suitability assessment of natural raw materials essentially requires principles and concepts of Applied Chemistry for technicians. The course aims to supplement the factual knowledge gained in the lectures by first hand manipulation of processes and apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering problems.

### Learning Outcomes:

At the end of the course student will be able to

- To express quantitative measurements accurately.
- To practice and adapt good measuring techniques.
- To use various apparatus for precise measurements.
- To understand and differentiate different methods of quantitative analysis.
- To know and understand principles of quantitative analysis using instruments.

### **LIST OF PRACTICALS:**

Perform any 12 (twelve) Laboratory Practical.

#### **Volumetric and Gravimetric analysis:**

- 1 Preparation of standard solution of oxalic acid or potassium permanganate.
- 2 To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
- 3 Standardization of  $\text{KMnO}_4$  solution using standard oxalic acid and determine the percentage of Iron present in given Hematite ore by  $\text{KMnO}_4$  solution.
- 4 Iodometric estimation of copper in the copper pyrite ore.
- 5 Volumetric estimation of total acid number (TAN) of given oil.
- 6 Volumetric estimation of
  - a) Total hardness of given water sample using standard EDTA solution.
  - b) Alkalinity of given water sample using 0.01M sulphuric acid
- 7 Proximate analysis of coal
  - a) Gravimetric estimation moisture in given coal sample
  - b) Gravimetric estimation ash in given coal sample

#### **Instrumental analysis**

8. Determine the conductivity of given water sample.
9. Determination of the Iron content in given cement sample using colorimeter.
10. Determination of calorific value of solid or liquid fuel using bomb calorimeter.
11. Determination of viscosity of lubricating oil using Redwood viscometer.
12. Determination of flash and fire point of lubricating oil using Abel's flash point apparatus.
13. To verify the first law of electrolysis of copper sulfate using copper electrode.
14. Construction and measurement of emf of electrochemical cell (Daniel cell).
15. To study the effect of dissimilar metal combination.

### Text Book:

1. Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.

## Communication Skills in English

### Course Objectives:

Communication skills play an important role in career development. This course aims at introducing basic concepts of communication skills with an emphasis on developing personality of the students. Thus, the main objectives of this course.

To develop confidence in speaking English with correct pronunciation.

To develop communication skills of the students i.e. listening, speaking, reading and writing skills. To introduce the need for personality development-Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc.

### Course outcomes:

At the end of this course, the participants will:

- Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
- Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
- Also develop skills of group presentation and communication in team. Develop non-verbal communication such as proper use of body language and gestures.

### Course Content

#### Unit-1 Communication: Theory and Practice

- Basics of communication: Introduction, meaning and definition, process of communication etc.
- Types of communication: formal and informal, verbal, non-verbal and written Barriers to effective communication.
- 7 Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous).
- Art of Effective communication,
  - Choosing words
  - Voice
  - Modulation
  - Clarity
  - Time
  - Simplification of words
- Technical Communication.

#### Unit-2 Soft Skills for Professional Excellence

- Introduction: Soft Skills and Hard Skills.
- Importance of soft skills.
- Life skills: Self-awareness and Self-analysis, adaptability, resilience, emotional intelligence and empathy etc.
- Applying soft skills across cultures.
- Case Studies.

### Unit-3: Reading Comprehension

Comprehension, vocabulary enhancement and grammar exercises based on reading of the following texts:

Section-1

*Malgudi Days*: R.K. Narayan

*The Room on*

*Roof*: Ruskin

Bond “The Gift

of the Magi” by

O. Henry

“Uncle Podger Hangs a Picture” Jerome K. Jerome

Section-2

Night of the Scorpion by Nissim Ezekiel,

Stopping by Woods on a Snowy

Evening by Robert Frost, Where the

Mind is Without Fear by Rabindranath

Tagore, Ode to Tomatoes by Pablo

Neruda,

### Unit-4: Professional Writing

The art of

précis writing,

Letters:

business and

personnel,

Drafting e-mail, notices, minutes of a meeting etc.

Filling-up different forms such as banks and on-line forms for placement etc.

Vocabulary and Grammar

Vocabulary of commonly used words

Glossary of administrative terms

(English and Hindi) One-word

substitution, Idioms and phrases

etc.

Parts of speech, active and passive voice, tenses etc., Punctuation

### References:

1. M. Ashraf Rizvi. *Effective Technical Communication*. Mc-Graw Hill: Delhi, 2002.

## Communication Skills in English – Lab

### Course Objectives:

Communication skills play an important role in career development. This lab course aims at actively involving students in various activities to improve their communication skills with an emphasis on developing personality of the students. Thus, the objectives of this course are:

1. To develop listening skills for enhancing communication.
2. To develop speaking skills with a focus on correct pronunciation and fluency.
3. To introduce the need for Personality development- Focus will be on developing certain qualities which will aid students in handling personal and career challenges, leadership skills etc. for that purpose group discussion, extempore and other activities should be conducted during lab classes.

### Learning Outcome:

- At the end of this course the students will be able to communicate effectively with an increase in their confidence to read, write and speak English fluently.
- They will also demonstrate a significant increase in word power.
- The variety of exercises and activities that will be conducted in the Language Lab will develop their skills needed to participate in a conversation like listening carefully and respectfully to others viewpoints; articulating their own ideas and questions clearly and over all students will be able to prepare, organize, and deliver an engaging oral presentation.
- They will also develop non-verbal communication such as proper use of body language and gestures.

### Course Content:

#### **Unit 1 Listening Skills**

Listening Process and Practice: Introduction to recorded lectures, poems, interviews and speeches, listening tests.

#### **Unit II : Introduction to Phonetics**

Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), weak forms, syllable division, word stress, intonation, voice etc.

#### **Unit III : Speaking Skills**

Standard and formal speech: Group discussion, oral presentations, public speaking, business presentations etc. Conversation practice and role playing, mock interviews etc.

#### **Unit IV : Building vocabulary**

Etymological study of words and construction of words, phrasal verbs, foreign phrases, idioms and phrases. Jargon/ Register related to organizational set up, word exercises and word games to enhance self-expression and vocabulary of participants.

### Recommended Readings:

1. Daniel Jones. *The Pronunciation of English*. Cambridge: Cambridge University Press, 1956.

# Engineering Graphics

## Course Objectives:

- To understand the language of graphics which is used to express ideas, convey instructions while carrying out engineering jobs.
- To develop drafting and sketching skills, to know the applications of drawing equipments, and get familiarize with Indian Standards related to engineering drawings.
- To develop skills to visualize actual object or a part of it, on the basis of drawings.
- To develop skills to translate ideas into sketches and to draw and read various engineering curves, projections and dimensioning styles.
- To understand the basic commands and develop basic skills related to computer aided drafting, how to draw, modify, and edit basic shapes (2D), using AUTOCAD.

## Course Outcomes

Following outcomes will be achieved:

- 1) Select and construct appropriate drawing scales, use drawing equipments, and understand Indian Standards of engineering drawing
- 2) Draw views of given object and components 3) Sketch orthographic projections into isometric projections and vice-versa.
- 3) Apply computer aided drafting tools to create 2D engineering drawings

## Course Content

### Unit – I Basic elements of Drawing

Drawing Instruments and supporting materials: method to use them with applications.

Convention of lines and their applications.

Representative Fractions – reduced, enlarged and full size scales; Engineering Scales such as plain and diagonal scale.

Dimensioning techniques as per SP-46:2003 – types and applications of chain, parallel and coordinate dimensioning.

Geometrical and Tangency constructions. (Redraw the figure)

### Unit – II Orthographic projections

Introduction of projections-orthographic, perspective, isometric and oblique: concept and applications (No question to be asked in examination).

Introduction to orthographic projection, First angle and Third angle method, their symbols.

Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Projection method only)

### Isometric Projections:

Introduction to isometric projections. Isometric scale and Natural scale. Isometric view and isometric projection.

Illustrative problems related to objects containing lines, circles and arcs shape only. Conversion of orthographic views into isometric view/projection.

### **Unit – III Free Hand Sketches of engineering elements**

Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washer, locking arrangements. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching)

Free hand sketches of orthographic view (on squared graph paper) and isometric view (on isometric grid paper)

### **Unit – IV Computer aided drafting interface**

Computer Aided Drafting: concept.

Hardware and various CAD software available. System requirements and understanding the interface.

Components of AutoCAD software window: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify tool bar, cursor cross hair. Command window, status bar, drawing area, UCS icon.

File features: New file, Saving the file, Opening an existing drawing file, Creating templates, Quit.

Setting up new drawing: Units, Limits, Grid, Snap. Undoing and redoing action.

#### **Computer aided drafting:**

Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, PolyLine.

Method of Specifying points: Absolute coordinates, Relative Cartesian and Polar coordinates.

Modify and edit commands like trim, extend, delete, copy, offset, array, block, layers.

Dimensioning: Linear, Horizontal Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions.

Continuous, Diameter, Radius, Angular Dimensions.

**Text Books:** Single line Text, Multiline text.

Standard sizes of sheet. Selecting Various plotting parameters such as Paper size, paper units, Drawing orientation, plot scale, plot offset, plot area, print preview.

Text: Single line Text, Multiline text.

## **Environmental Science**

### **Course Objectives:**

Technicians working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce most efficient, economical and eco-friendly finished products.

- Solve various engineering problems applying ecosystem to produce eco – friendly products.
- Use relevant air and noise control method to solve domestic and industrial problems.
- Use relevant water and soil control method to solve domestic and industrial problems.
- To recognize relevant energy sources required for domestic and industrial applications.
- Solve local solid and e-waste problems.

### **Course outcomes:**

At the end of the course student will be able to

1. Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
2. Understand the suitable air, extent of noise pollution, and control measures and acts.
3. Understand the water and soil pollution, and control measures and acts.
4. Understand different renewable energy resources and efficient process of harvesting.
5. Understand solid Waste Management, ISO 14000 & Environmental Management.

### **Course Content:**

Pre requisite: - High School Chemistry

#### **Unit-1 Ecosystem**

- Structure of ecosystem, Biotic & Abiotic components
- Food chain and food web
- Global warming -Causes, effects, process, Green House Effect, Ozone depletion

#### **Unit– 2 Air and Noise Pollution**

- Definition of pollution and pollutant, Natural and manmade sources of air pollution
- Air Pollutants: Types, Particulate Pollutants: Effects and control of air pollution
- Noise pollution: sources of pollution, Effects and control of Noise pollution

#### **Unit- 3 Water and Soil Pollution**

- Sources of water pollution, Types of water pollutants, Characteristics of water pollutants  
Turbidity, pH, total suspended solids, total solids BOD and COD: Definition
- Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers,  
Pesticides and Insecticides, Irrigation, E-Waste.

- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste.

#### **Unit– 4 Renewable sources of Energy**

- Solar Energy: Basics of Solar energy. Solar pond. Solar water heater, solar dryer.
- Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.
- Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy.
- New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy
- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste.

#### **References:**

#### **Text Books:**

1. S.C. Sharma & M.P. Poonia, Environmental Studies, Khanna Publishing House, New Delhi
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.  
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## Introduction to IT Systems

### Course Objectives:

This course is intended to make new students comfortable with computing environment - Learning basic computer skills, Learning basic application software tools, Understanding Computer Hardware, Cyber security awareness

### Course outcomes:

At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/ attacks.

### Course Content:

#### **UNIT 1:**

Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital

India portals (state and national portals) and college portals.

General understanding of various computer hardware components – CPU, Memory, Display, Key-board, Mouse, HDD and other Peripheral Devices.

#### **UNIT 2:**

OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor.

**UNIT 3:** HTML4, CSS, making basic personal webpage.

**UNIT 4:** Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.

#### **Information security best practices.**

Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.

#### **Suggested Lab Work:**

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. This course is all about some theory and a lot of practice.

#### References:

R.S. Salaria, Computer Fundamentals, Khanna Publishing House

Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House

Online Resources, Linux man pages, Wikipedia

Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett

## Introduction to IT Systems Lab

### Course Objectives:

This Lab course is intended to practice whatever is taught in theory class of „Introduction of IT Systems“ and become proficient in using computing environment - basic computer skills, basic application software tools, Computer Hardware, cyber security features, etc.

### Course outcomes:

At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/attacks.

### Course Content:

S.No.	Topics for Practice
1	Browser features, browsing, using various search engines, writing search queries
2	Visit various e-governance/Digital India portals, understand their features, services offered
3	Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognise various ports/interfaces and related cables, etc.
4	Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times
5	Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6	Practice HTML commands, try them with various values, make your own Webpage
7	Explore features of Open Office tools, create documents using these features, do it multiple times
8	Explore security features of Operating Systems and Tools, try using them and see what happens.

This is a skill course. More you practice, better it will be.

### References:

1. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.
2. IT Essentials PC Hardware and Software Companion Guide, Davis Anfinson and Ken Quamme, CISC Press, Pearson Education.

## Applied Physics –II

### Course Objectives

Applied Physics aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content. The course will help the diploma engineers to apply the basic concepts and principles to solve broad-based engineering problems and to understand different technology based applications.

Learning Outcome:

After undergoing this subject, the student will be able to;

- a) Describe waves and wave motion, periodic and simple harmonic motions and solve simple problems. Establish wave parameters: frequency, amplitude, wavelength, and velocity and able to explain diffraction, interference, polarization of waves.
- b) Explain ultrasonic waves and engineering, medical and industrial applications of Ultrasonics.  
Apply acoustics principles to various types of buildings for best sound effect.
- c) State basic optical laws, establish the location of the images formed by mirrors and thin converging lens, design and assemble microscope using lenses combination.
- d) Describe refractive index of a liquid or a solid and will be able to explain conditions for total internal reflection.
- e) Define capacitance and its unit, explain the function of capacitors in simple circuits, and solve simple problems.
- f) Differentiate between insulators, conductors and semiconductors, and define the terms: potential, potential difference, electromotive force.

### Course Content

#### **UNIT - 1: Wave motion and Optics**

Wave motion, transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation ( $y = r \sin \omega t$ ) amplitude, phase, phase difference, principle of superposition of waves and beat formation.

Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications,

Basic optical laws; reflection and refraction, refractive index, Images and image formation by mirrors, lens and thin lenses, lens formula, power of lens, magnification. Total internal reflection, Critical angle and conditions for total internal reflection, applications of total internal reflection in optical fiber

## **UNIT -2 : Electrostatics and Current Electricity**

Coulombs law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference

Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors

Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire. Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications, Describe Meter bridge Experiment for determination of specific resistance with neat circuit diagram, problems Solving

## **UNIT - 3: Electromagnetism**

Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization.

Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in magnetic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field. Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.

## **UNIT - 4: Modern Physics**

Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Photocells, Solar cells; working principle and engineering applications.

Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers.

Nanoscience and Nanotechnology: Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology and applications.

## Applied Physics Labs –II

### Course Objectives:

Concrete use of physical principles and analysis in various fields of engineering and technology is very prominent. The course aims to supplement the factual knowledge gained in the lecture by first hand manipulation of apparatus. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering and technology based problems. In addition, students get necessary confidence in handling equipment and thus learn various skills in measurement.

### Learning Outcome:

After undergoing this subject, the student will be able to;

- a) Apply concept of vibrations and determine the time period of vibrating objects.
- b) *Use of equipment for determining velocity of ultrasonics in different liquids.*
- c) Verify optical laws; reflection, refraction from plane interfaces and surfaces.
- d) Apply knowledge of optics to determine focal length and magnifying power of optical lenses.
- e) Understand uses of electrical components and meters and verify Ohm's law for flow of current.
- f) Quantify resistances and verify laws of series and parallel combination of resistances.
- g) Apply concept of electrical vibrations in determine frequency of AC main.
- h) Analyse electrical circuits and verify Kirchhoff's law governing electrical circuits.
- i) Measure resistance of a galvanometer and how it is converted into an ammeter and volt- meter.
- j) Investigate characteristics of semiconductor diodes, photoelectric cells and determine operational parameters associated with their performance.
- k) Work with laboratory lasers and understand method to measure the wavelength of the light emitted from a laser.
- l) Handle optical fibers and determine numerical aperture of given optical fiber.
- m) Understand construction and working of an optical projection system.

### List of Practicals/Activities:

1. Determine the Velocity of sound in air using resonance column Apparatus at room temperature and at 0°C.
2. To verify laws of refraction (Snell's law) using a glass slab.

3. To determine focal length and magnifying power of a convex lens.
4. Determine the resistance and specific resistance of the wire using Meter Bridge
5. To verify laws of resistances in series and parallel combination.
6. To verify Ohm's law by plotting graph between current and potential difference.
7. Draw the lines of force of combined magnetic field due to bar magnet in earth's magnetic field by locating the null points when North pole of the bar magnet pointing towards Geographical North of the Earth.
- 8.. Draw the lines of force of combined magnetic field due to bar magnet in earth's magnetic field by locating the null points when North pole of the bar magnet pointing towards Geographical North of the Earth
9. To convert a galvanometer into an ammeter.
10. To convert a galvanometer into a voltmeter.
11. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
12. To measure numerical aperture (NA) of an optical fiber.

## Engineering Mechanics

Course Objectives:

Following are the objectives of this course:

- 1) To obtain resultant of various forces
- 2) To calculate support reactions through conditions of equilibrium for various structures
- 3) To understand role of friction in equilibrium problems

Course outcomes:

After completing this course, student will be able to:

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.

Course Contents:

### Unit – I Basics of mechanics and force system

Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics.

Space, time, mass, particle, flexible body and rigid body.

Scalar and vector quantity, Units of measurement (SI units) - Fundamental units and derived units.

Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a

force, Principle of transmissibility of force, Force system and its classification.

Resolution of a force - Orthogonal components of a force, moment of a force, Varignon's Theorem.

Composition of forces – Resultant, analytical method for determination of resultant for concurrent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

### Unit– II Equilibrium

Equilibrium and Equilibrant, Free body diagram, Analytical method of analysing equilibrium.

Lami's Theorem – statement and explanation, Application for various engineering problems.

Types of beams, supports (hinge, roller and fixed) and loads (vertical, inclined point load & uniformly distributed load) acting on the beam.

Beam reaction for cantilever, simply supported beam with or without overhang – subjected to Point load, uniformly distributed load and combination of loads.

### Unit– III Friction

Introduction - Theory of Friction - Angle of friction - Laws of Friction - Static

and Dynamic Frictions- Wedge Friction, Screw-jack and Differential Screw-jack

Equilibrium of bodies on level surface subjected to force parallel and inclined to plane.

#### **Unit- IV Centroid**

Introduction to Centroid, Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle). Centroid of T, L, I, Channel section, Z section, Unsymmetrical I section and Built-up sections.

Text Book:

1. Khurmi, R.S., Applied Mechanics, S. Chand &Co. New Delhi.



## Engineering Mechanics Lab

### Course Objectives:

Following are the objectives of this course:

- 1) To obtain resultant of various forces
- 2) To calculate support reactions through conditions of equilibrium for various structures
- 3) To understand role of friction in equilibrium problems
- 4) To know fundamental laws of machines and their applications to various engineering problems

### Course outcomes:

After completing this course, student will be able to

1. Identify the force systems for given conditions by applying the basics of mechanics.
2. Determine unknown force(s) of different engineering systems.
3. Apply the principles of friction in various conditions for useful purposes.
4. Find the centroid and centre of gravity of various components in engineering systems.
5. Select the relevant simple lifting machine(s) for given purposes.

### List of Practical to be performed:

1. To study various equipments related to Engineering Mechanics.
2. To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
3. Determine resultant of concurrent force system applying Law of Polygon of forces using force table.
4. Determine resultant of concurrent force system graphically.
5. Determine resultant of parallel force system graphically.
6. Verify Lami's theorem.
7. Study forces in various members of Jib crane.
8. Determine support reactions for simply supported beam.
9. Obtain support reactions of beam using graphical method.
10. Determine coefficient of friction for motion on horizontal and inclined plane.
11. Determine centroid of geometrical plane figures.

### Text Book:

1. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.

# Fundamentals of Electrical and Electronics Engineering

## Course Objectives:

To provide basic knowledge of the different elements and concepts of electrical engineering field and to learn basic concepts of various active and passive electronic components, Signals, Op-Amp and their applications, Digital Electronics and their applications to help students deal with electrical and electronics engineering principles and applications in industrial processes of different fields.

## Outcomes:

1. Understand the basics of analog and digital electronics
2. Analyze eclectic and magnetic circuits
3. Understand the working of transformers and machines.

## Course Contents:

### UNIT I Overview of Electronic Components & Signals:

Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values.

### UNIT II Overview of Analog and Digital Circuits:

Operational Amplifiers-Ideal Op-Amp, Practical op amp, Application of Op-Amp as amplifier, adder, differentiator and integrator.

Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach.

### Unit III Electric and Magnetic Circuits:

EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equations of self and mutual inductance; Analogy between electric and magnetic circuits.

### Unit IV A.C. Circuits, Transformers and Machines

Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; General construction and principle of transformer; Emf equation and transformation ratio of transformers; Construction and Working principle of motors; Basic equations and characteristic of motors.

## Text Book:

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House

## Fundamentals of Electrical and Electronics Engineering Lab

### Course Objectives:

To provide basic knowledge of the different elements and concepts of electrical engineering field and to learn basic concepts of various active and passive electronic components, Signals, Op-Amp and their applications, Digital Electronics and their applications to help students deal with electrical and electronics engineering principles and applications in industrial processes of different fields.

### Course Outcomes:

At the end of the course student will be able to:

1. Understand basic principle and operation of electric circuits and machines.
2. Solve basic problems related to electrical circuits and machines. Explain the operation of different electrical technologies.
3. Demonstrate an understanding of the control systems.
4. Understand the basic circuit elements
5. Understand different types of signal wave forms.
6. Understand logic gates and apply them in various electronic circuits.
7. Understand the basic concepts of op-amps, and their applications.
8. Use relevant electric/electronic protective devices safely.

S. No.	List of Experiments	Approx. Hrs.
1.	Determine the value of given resistor using digital multimeter to confirm with colour code.	02
2	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	02
3	Use LCR-Q tester to measure the value of given capacitor and inductor.	02
4	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	02
5	Measure voltage, current and power in 1-phase circuit with resistive load.	02

6	Measure voltage, current and power in R-L series circuit.	02
7	Test the performance of PN-junction diode.	02
8	Test the performance of Zener diode.	02
9	Determine the current gain of CE transistor configuration.	03
10	Determine the transformation ratio (K) of 1-phase transformer.	03

**Text Book:**

Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House,2018

## Mathematics - II

### Course Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, Basic elements of vector algebra and First Order Differential Equations.

### Course Outcomes:

By the end of the course the students are expected to learn

- (i) the students are expected to acquire necessary background in Determinants and Matrices so as to appreciate the importance of the Determinants are the factors that scale different parameterizations so that they all produce same overall integrals, i.e. they are capable of encoding the inherent geometry of the original shape.
- (ii) the cumulative effect of the original quantity or equation is the Integration
- (iii) the coordinate geometry provides a connection between algebra and geometry through graphs of lines and curves.
- (iv) Tell the difference between a resultant and a concurrent force to model simple physical problems in the form of a differential equation, analyze and interpret the solutions.

### Course Content:

#### UNIT - I: Determinants and Matrices

Elementary properties of determinants up to 3rd order, consistency of equations, Cramer's rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.

#### UNIT - II: Integral Calculus

Integration as inverse operation of differentiation. Simple integration by substitution, by parts

and by Partial fractions (for linear factors only). Use of formulas  $\int_0^{\frac{\pi}{2}} \sin^n x dx$ ,  $\int_0^{\frac{\pi}{2}} \cos^n x dx$  and

$$\int_0^{\frac{\pi}{2}} \sin^n x \cos^n x dx$$

#### UNIT - II: Integral Calculus

Integration as inverse operation of differentiation. Simple integration by substitution, by parts

and by partial fractions (for linear factors only). Use of formulas  $\int_0^{\frac{\pi}{2}} \sin^n x dx,$

$\int_0^{\frac{\pi}{2}} \cos^n x dx,$  and  $\int_0^{\frac{\pi}{2}} \sin^n x \cos^n x dx$  for solving problems Where m and n are

positive integers. Applications of integration for i. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems).

### **UNIT - III: Co-Ordinate Geometry**

Equation of straight line in various standard forms (without proof), inter section of two straight lines, angle between two lines. Parallel and perpendicular lines, perpendicular distance formula.

General equation of a circle and its characteristics. To find the equation of a circle, given:

- i. Centre and radius,
- ii. Three points lying on it and
- iii. Coordinates of end points of a diameter;

Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations without proof. Problems

on conics when their foci, directrices or vertices are given.

### **UNIT - IV: Vector Algebra**

Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar

and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.

### **Differential Equations**

Solution of first order and first degree differential equation by variable separation method (simple problems). MATLAB – Simple Introduction.

### **Text Books:**

1. Text book of Intermediate Mathematics-I & II by Telugu Academy.
2. A Text book of Engineering Mathematics –II , III by Radiant Publication.

## Engineering Workshop Practice

### Course Objectives:

- To understand basic engineering processes for manufacturing and assembly.
- To understand, identify, select and use various marking, measuring, and holding, striking and cutting tools and equipment's
- To understand and interpret job drawings, produce jobs, and inspect the job for specified Dimensions
- To understand the various types of wiring systems and acquire skills in housewiring
- To understand, operate, control different machines and equipment's adopting safety practice

### Course outcomes

At the end of the course, the student will be able to:

CO1	Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines
CO2	Understand job drawing and complete jobs as per specifications in allotted time
CO3	Inspect the job for the desired dimensions and shape
CO4	Operate, control different machines and equipment's adopting safety practices

### Course Content:

S.No.	Details Of Practical Content
I	<b>Carpentry:</b> i) Demonstration of different wood working processes, like planing, marking, chiseling, turning of wood etc. ii) One simple job involving any one joint like mortise and tendon dovetail, bridle, half lap etc. <b>Fitting:</b> i) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. ii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc.
II	<b>Welding:</b> i) Demonstration of different welding tool. ii) Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint <b>Sheet Metal Working:</b> i) Demonstration of different sheet metal operations like sheet cutting, bending, edging, lancing, soldering, and riveting. ii) One simple job involving sheet metal operations and soldering and riveting
III	<b>Electrical House Wiring:</b> Practice on simple lamp circuits (i) one lamp controlled by one switch by surface conduit wiring, (ii) Lamp circuits- connection of lamp and socket by separate switches,
IV	<b>Demonstration:</b> i) Demonstration of measurement of Current, Voltage, Power and Energy. ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. iii) Tools for Cutting and drilling

### References:

1. S.K. Hajara Chaudhary, Workshop Technology, Media Promoters and Publishers, New Delhi, 2015

## Curriculum Structure for III, IV, V and VI Semesters

<b>Semester-III</b>							
Sl. No	Category	Course Title	Hours per week			Total contact hrs/ week	Credits
			L	T	P		
1	Program core course	Thermodynamics	3	0	0	3	3
2	Program core course	Manufacturing Engineering	0	0	3	3	3
3	Program core course	Automotive Chassis and Components	3	0	0	3	3
4	Program core course	Hydraulic and Pneumatic Control System	2	1	0	3	3
5	Program core course	Automotive Electrical and Electronic Systems	3	0	0	3	3
6	Program core course	Thermal engineering lab	0	0	3	3	1
7	Program core course	Automotive Chassis and Components Lab	0	0	2	2	1
8	Program core course	Hydraulic and pneumatic controls Lab	0	0	3	3	1
9	Program core course	Manufacturing Engineering Lab	0	0	2	2	1
10	Summer Internship-I (4weeks)after II Semester	Internship-I	0	0	0	0	2
<b>Total</b>							<b>21</b>



## Semester-IV

S.No.	Category	Course Title	Hours per week			Total contact hrs/ week	Credits
			L	T	P		
1	Program core course	Automotive Engines	2	1	0	3	3
2	Program core course	Strength of Materials	2	1	0	3	3
3	Program core course	Automotive transmission system	2	1	0	3	3
4	Program Elective course	1. Alternate fuel and energy system 2. Modern vehicle technologies 3. vehicle body engineering	3	0	0	3	3
5	Program Elective course	1. Electrical vehicles 2. Automotive Safety 3. Automotive Air conditioning	3	0	0	3	3
6	Program core course	Automotive Engine and Vehicle Components Lab	0	0	2	2	2
7	Program core course	Automotive engineering CAD/CAM lab	0	0	2	2	1
8	Program core course	Automotive engine testing and pollution control lab	0	0	2	2	1
9	Minor Project	Project work	0	0	4	4	2
10	Mandatory Course	Essence of Indian Knowledge and Tradition	2	0	0	2	0
<b>Total</b>						<b>21</b>	

Course Code	:	
Course Title	:	Thermodynamics
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To teach students about different views of thermodynamic approach.
- To teach students about thermodynamic systems with practical examples.
- To teach students about different laws of thermodynamics and their practical significance.
- To teach students about Transformation of phases, Gas laws and Thermodynamic cycles.

**Course Outcomes:**

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

- Analyze a thermodynamic system from macroscopic view point.
- Compute work and heat transfers across system boundaries.
- Apply first and second law of thermodynamics in closed and open systems involving steady flow.
- Comprehend Entropy and causes of irreversibility of a process.
- Apply gas laws applicable to ideal gas in order to determine thermodynamic properties.

**Course Content:**

**UNIT-I**

**INTRODUCTION:**

Thermodynamic Systems, Concept of Continuum, Thermodynamic Equilibrium, Thermodynamic State, Properties, Process and Cycle. Quasi-Static process, Reversible and Irreversible process. Energy, Work and Heat. Point and Path Functions.

Zeroth Law of Thermodynamics, Temperature Scale, Ideal Gas Thermometer. Joule's Experiment, Pdv-work, Simple problems on Pdv-work.

Representations of different processes on P-V and T-S diagram. Simple Problems on different processes.

**UNIT-II**

**First Law of Thermodynamics:**

Corollaries of First Law- Internal Energy, PMM-I. First Law applied to Flow Process-SFEE. Application of SFEE, Simple problems.

**Second Law of Thermodynamics:**

Clausius Statement, Kelvin-Planck Statement. Corollaries of Second Law- PMM-II, Entropy. Principle of increase in Entropy, Clausius Inequality. Thermal Reservoir, Heat Engine, Problems on Heat Engine. Carnot's Principle, Carnot

Cycle, Representation on P-V and T-S diagrams, Expression for Thermal Efficiency. Simple Problems.

**UNIT-III**

**Phase Transformation:**

Phase change of pure substance, Phase Transformation of ice to steam. Triple Point, PVT surface.

**Air compressor:**

construction and working of air compressor, types of compressor, reciprocating single acting, double acting, single stage, multi stage, rotary air compressors.

## **UNIT-IV**

### **Air Standard Cycle:**

Terminology of Air Standard Cycle, Types of Air Standard Cycle- Carnot cycle, reverses carnot cycle, Otto Cycle, Diesel Cycle, Dual Combustion Cycle, Brayton's or Joule's Cycle- Rankine Cycle.

### **Reference Books:**

1. Engineering Thermodynamics by P. K. Nag, Tata Mc-Graw-Hill Education.
2. Thermodynamics: An Engineering Approach by Michael A. Boles and Yunus A. Cengel. Tata Mc-Graw-Hill Education.
3. Thermal Engineering by R.S.Khurmi. S.Chand.

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Course Code	:	
Course Title	:	Manufacturing Engineering
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To understand the importance of cutting fluids & lubricants in machining.
- To study various types of basic production processes. To select, operate and control the appropriate processes for specific applications.
- To understand the concept of gear making and list various gear materials.
- To understand the importance of press tools, various die preparations, grinding and finishing processes.

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Know and identify basic manufacturing processes for manufacturing different components.

CO2: Operate & control different machines and equipment's.

CO3: Produce jobs as per specified dimensions and inspect the job for specified dimensions.

CO4: Select the specific manufacturing process for getting the desired type of output in grinding and finishing process.

**Course Content:**

**Units-I: Machining processes:** Metal cutting process, Cutting tool materials, machining parameters: speed feed depth of cut, types of chips. Cutting fluids: types; characteristics and applications.

**Cutting Tool Geometry:** Single point cutting tool; tool signature.

**Lathe Operations:** Types of lathes, Specifications; Basic parts and their functions; Operations and tools – Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.

**Units-II: Drilling:** Classification; Specifications of drilling machine; Basic parts and their functions; Radial drilling machine; Types of operations; Types of drills, Boring operation, types of boring machines, reaming processes. Shaper, Planer, Slotting: Construction, operation, application.

**Unit-III: Milling:** Introduction; Types of milling machines: plain, Universal, vertical; constructional details– specifications; Milling operations: simple, compound and differential indexing; Milling cutters –types; Nomenclature of teeth; Tool & work holding devices.

**Grinding Machines and Finishing Processes:** Types of grinding, Abrasives and bonds used for grinding wheels. Specification of grinding wheels. Broaching, Honing, Polishing, Buffing and super finishing.

**Unit-IV: Welding:** Classification; Gas welding techniques; Types of welding flames; Arc Welding –Principle, Equipment, Applications Shielded metal arc welding; Submerged arc welding; TIG/MIG welding; Resistance welding - Spot welding, Seam welding, Projection welding; Welding defects; Brazing and soldering: Types, Principles, Applications. Press working operations - cutting, bending, drawing, punching, blanking, notching, lancing.

**Reference Books:**

1. Manufacturing technology – P N Rao, Tata McGraw-Hill Publications
2. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, Media Promoters and Publishers Limited.
3. Production Technology (Volume I & II) – O. P. Khanna & Lal, Dhanpat Rai Publications.
4. Fundamental of metal cutting and machine tools– B. L. Juneja, New age international limited.
5. Manufacturing Technology, Metal Cutting & Machine tools– P. N. Rao, Tata McGraw-Hill Publications.
6. Production Technology – R.B. Gupta, Satya Prakashan, New Delhi.

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Course Code	:	
Course Title	:	Automotive Chassis and Components
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To study various types Chassis layout and frames.
- To understand the concept of Steering Systems and steering gear boxes.
- To understand the concept of differential principles.
- To understand the concept of braking systems.

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Know and identify chassis layout and types of frames.

CO2: Know the Drive line and Differential principles.

CO3: Know the mechanism of Braking systems.

CO4: Know different types of Suspension systems.

**Course Content:**

**Units-I:**

**Chassis and frame:** Types of chassis layout with reference to power plant locations and drive, Vehicle frames, Various types of frames, Constructional details, Materials, Testing of vehicles frames, Unitised frame body construction, Loads acting on vehicle frame.

**Front axle and Steering System:** Types of front axle, Construction details, Materials, Conditions for true rolling motion of wheels during steering, Steering geometry, Constructional details of steering linkages, Different types of steering gear boxes, Steering linkages and layouts, Power and Power assisted steering, Steering of crawler tractors.

**Units-II:**

**Drive Line:** Effect of driving thrust and torque reactions. Hotch Kiss drive, torque tube drive and radius rods. Propeller shaft. Universal joints. Constant velocity universal joints. Front wheel drive.

**Final Drive Differential:** Different types of final drive. Worm and wormwheel, Straight bevel gear, Spiral bevel gear and hypoid gear final drives. Differential principles. Construction details of differential unit. Non-slip differential. Differential locks.

**Unit-III:**

**Rear Axles:** Construction of rear axles. Types of loads acting on rear axles. Full floating. Three quarter floating and semi floating rear axles. Rear axle housing. Construction of different types of axle housings. Multi-axle vehicles. Construction details of multi drive axle vehicles.

**Braking System:** Classification of brakes, drum brake & disc brakes. Constructional details-Theory of braking. Mechanical hydraulic and Pneumatic brakes. Servo brake. Power and power assisted brakes- different types of retarders like eddy current and hydraulic retarder. Antilock braking systems.

**Unit-IV:**

**Suspension system:** requirement of suspension system, types of suspension, construction and working of Multi-Link Suspension.

Rigid Axle Suspension, Macpherson Suspension, Double Wishbone Suspension, Independent Suspension, Rigid suspension – Leaf Spring, Trailing Arm Suspension, Air Suspension.

## Reference Books:

1. Heldt.P.M.,Automotive Chassis, Chilton Co., New York,1990.
2. Steed.W.,Mechanics of Road Vehicles,IIIiffe Books Ltd.,London,1960.
3. Crouse.W.H, Automotive Chassis and Body, McGraw Hill New York, 1971
4. Newton. Steeds & Garrot.Motor Vehicles, Butterworths, London, 1983.
5. Judge.A.W.Mechanism of the car, Chapman and Halls Ltd., London1986.

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Course Code	:	
Course Title	:	Hydraulic and Pneumatic Control System
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To study various types of Hydraulic Systems and Pneumatic Systems.
- To study various types of Hydraulic pipes and Control valves.
- To study various types of ISO symbols used in hydraulic and pneumatic circuits.
- To study constructional details and operation of various types of hydraulic and pneumatic devices.

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Know and identify Hydraulic Systems and Pneumatic Systems.

CO2: Know the Hydraulic pipes and Control valves.

CO3: Know the various ISO symbols used in hydraulic and pneumatic circuits.

CO4: Know constructional details and operation of various types of hydraulic and pneumatic devices.

**Course Content:**

**Units-I:**

Power transmission modes. 1.2 Hydraulic systems. 1.3 Pneumatic systems 1.4 Laws governing fluid flow: Pascal's law, continuity equation, Bernoulli's theorem, Boyle's, Charles', Gay-lussec' laws. 1.5 Flow through pipes - types, pressure drop in pipes, Working fluids used in hydraulic and pneumatic systems.

**Units-II:**

Hydraulic pipes-Types, standards, designation methods and specifications, pressure ratings, applications and selection criteria. 2.2 Pumping theory, Hydraulic Pumps - types, construction, working principle, applications, selection criteria and comparison. 2.3 Hydraulic Actuators, Control valves, Accessories - their types, construction and working 2.4 Pneumatic Pipes - materials, designations, standards, properties and piping layout. 2.5 Air compressors, Air receivers, air dryers, Air Filters, Regulators, Lubricators (FRL unit): their types, construction, working, specifications and selection criteria of following air preparation and conditioning elements 2.6 Pneumatic Actuators and Control valves - types, construction, working, materials and specifications

**Unit-III:**

ISO symbols used in hydraulic and pneumatic circuits. 3.2 Basic Hydraulic Circuits – types (such as intensifier, regenerative, synchronizing, sequencing, speed control, safety), circuit diagram, components, working and applications. 3.3 Basic Pneumatic Circuits – types (such as speed control, two step feed control, automatic cylinder reciprocation, time delay, quick exhaust), circuit diagram, components, working and applications. 3.4 Pneumatic Logic circuit design - classic method, cascade method, step counter method, karnaughveitch maps and combinational circuit design.

**Unit-IV:**

Hydraulic and Pneumatic devices – Concept and applications. 4.2 Construction, working principle, major elements, performance variables of: Automotive hydraulic brake, Industrial Fork lift, Hydraulic



jack, Hydraulic press, Automotive power steering, Automotive pneumatic brake, Automotive air suspension, Pneumatic drill, Pneumatic gun.

**Reference Books:**

1. Majumdar, S.R. Oil Hydraulic Systems Tata Mcgraw-Hill Publication, New Delhi,3/e, 2013
2. Majumdar, S.R. Pneumatic Systems Tata Mcgraw-Hill Publication, New Delhi,3/e, 2013
3. Srinivasan, R. Hydraulic and Pneumatic Controls Vijay Nicole Imprints Private, New Delhi, Limited, 2/e, 2008
4. Jagadeesha, T. Fluid Power Generation, Transmission and Control Universities Press (India) Private Limited, New Delhi,1/e, 2014
5. Jagadeesha, T. Pneumatics Concepts, Design And Applications Universities Press (India) Private Limited, New Delhi,1/e, 2014
6. Parr, Andrew Hydraulic And Pneumatics A Technician's and Engineer's Guide Jaico Publishing House, New Delhi,2/e, 2013
7. Shanmuga Sundaram, K . Hydraulic And Pneumatics Controls - Understanding Made Easy S. Chand Company Ltd., New Delhi, 1/e, 2006
8. Hedges, Charles S. Industrial Fluid Power Vol. I, II, and III Womack Educational Publications, 3/e, 2009

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Course Code	:	
Course Title	:	Automotive Electrical and Electronics systems
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To study various types Batteries with their constructional features.
- To study various types of Charging systems and Starting systems.
- To study various types of Automotive Lighting systems and Accessories.
- To study constructional details and operation of various types of hydraulic and pneumatic devices.

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Know and identify Hydraulic Systems and Pneumatic Systems.

CO2: Know the Hydraulic pipes and Control valves.

CO3: Know the various ISO symbols used in hydraulic and pneumatic circuits.

CO4: Know constructional details and operation of various types of hydraulic and pneumatic devices.

**Course Content:**

**Units-I:**

**Batteries:** Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition. Solid state batteries, battery performance parameters, Lithium ion batteries, lithium phosphate batteries.

**Units-II:**

**Charging System:** Generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators. Compensated voltage regulator, alternators,

**Starting system:** ignition system, starter motor, bendix drive,

**Unit-III:**

**Lighting System & Accessories:** automobile lighting circuit, Insulated & earth return systems. Positive & negative earth systems. Details of head light & side light. Headlight dazzling & preventive methods. Instrument panel lighting and symbols, cabin ambient lighting, break light, Horn, Wiper system, follow me home feature.

**Unit-IV:**

**Sensors and transducers:** temperature measurements, speed measurement and pressure measurements and their applications in automobiles.

Sensors for Fuel level measurements, working of electromagnetic gauges like temperature, light sensor, rain sensor, impact sensors, engine oil pressure gauge, speedometer.

**Reference Books:**

Crouse. W.H. , Automobile Electrical Equipment, McGraw Hill Book Co Inc., New York, 1980

**T.Mellard Automotive Electronics**

Course Code	:	
Course Title	:	Thermodynamics Lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To understand the importance of fuel properties and learn the methods of determination of various properties of fuels.
- To understand the working principles of various methods used in determination of properties of fuels.
- To observe different parts of I.C. engine and understand their working.
- To identify the physical differences between S.I. and C.I. engines and 2-S & 4-S Engines.

**Course Outcomes:**

CO1: Understand the determination of flash and fire point of a given sample of fuel using given apparatus (Abels, Cleveland & Pinsky martin)

CO2: Understand the determination of Viscosity of a given sample of oil using given apparatus.

CO3: Understand the determination of Calorific value and carbon residue of a given sample of fuel using given apparatus.

CO4. Understand the port timing and valve timing diagrams of engines.

**Cycle I**

1. Flash & Fire point tests using Able's/Cleveland/ Pinsky Martin Apparatus.
2. Viscosity measurement using/Saybolt viscometer
3. Calorific value tests using Bomb Calorimeter (Solid and Liquid fuels) and Junkers Gas
4. Calorimeter (Gaseous fuels)
5. Carbon residue test using Conradson's apparatus.
6. Assembling and disassembling of I.C. Engines

**Cycle II**

1. Port timing diagram of Petrol engine
2. Port timing diagram of Diesel engine
3. Valve timing diagram of Petrol engine
4. Valve timing diagram of Diesel engine
5. Study of petrol and diesel engine components and Models.

**Reference Books:**

1. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering–S.Domkundwar& C.P. Kothandaraman, Dhanpat Rai & Publication New Delhi
3. Thermal Engineering – R.S. Khurmi and J.K. Gupta, 18th Edition, S. Chand & Co, New Delhi.

Course Code	:	
Course Title	:	Automotive Chassis and Components Lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To study various types of Automobile chassis for 2, 3 and 4 wheelers.
- To study various types of Automobile chassis for heavy vehicles.
- To study dismantling and assembling of Front and Rear axles, Steering systems and Braking systems.

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Understand Various types of Automobile chassis.

CO2: Able to dismantle and assemble front and rear axles.

CO3: Able to dismantle and assemble Steering system and Braking system.

CO4. Able to understand and assemble differential mechanism.

**Cycle I**

1. Study of various types of Automobile Chassis for 2 wheelers.
2. Study of various types of Automobile Chassis for 3 wheelers.
3. Study of various types of Automobile Chassis for 4 wheelers.
4. Study of various types of Automobile Chassis for heavy vehicles.
5. Study of various types of Automobile Chassis for Special purpose vehicles.

**Cycle II**

**Study, dismantling and assembling of**

1. Front axle,
2. Rear axle,
3. Overhauling of telescopic shock absorber
4. Overhauling of telescopic independent suspension system
5. Steering system,
6. Braking system,
7. Differential mechanism

**Reference Books:**

1. Automobile Chassis and Body Engineering, Sri. N.R.HEMA KUMAR.

Course Code	:	
Course Title	:	Hydraulics and Pneumatics Controls Lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To study various types of Automobile chassis for 2, 3 and 4 wheelers.
- To study various types of Automobile chassis for heavy vehicles.
- To study dismantling and assembling of Front and Rear axles, Steering systems and Braking systems.

**Course Outcomes:**

At the end of the course, the student will be able to:

CO1: Understand Various types of Automobile chassis.

CO2: Able to dismantle and assemble front and rear axles.

CO3: Able to dismantle and assemble Steering system and Braking system.

CO4. Able to understand and assemble differential mechanism.

**Cycle I**

- .1. Identify the components and Draw ISO symbols of hydraulic and pneumatic trainers.
2. Analyze the performance of Pump and Actuators mounted on hydraulic trainer.
3. Analyze the performance of control valves used in hydraulics and pneumatics.
4. Analyze the performance of compressor, FRL unit, special valves and accessories of pneumatics.
5. Construct and actuate hydraulic circuit for SAC, DAC and Hydro motor for the given purpose.
6. Construct and actuate Meter-in, Meter out Hydraulic circuit for the given purpose.

**Cycle II**

7. Construct and actuate hydraulic circuit for the given sequencing of operations.
8. Develop circuit for simple machine tool applications such as milling machine, shaper machine, grinding machine
9. Maintain simple parts of mobile hydraulic system such as in earth moving equipment's.
10. Construct and actuate Pneumatic circuit for SAC, DAC and Air motor for the given purpose.
11. Construct and actuate speed control Pneumatic circuits for the given purpose.

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Course Code	:	
Course Title	:	Manufacturing Engineering Lab
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	Basic Mechanical Engineering, Manufacturing Engineering
Course Category	:	PC

**Course Objectives:**

- To Practice the casting principles and operations in foundry.
- To Practice the operation of Lathe.
- To Practice the joining of metals using different Welding techniques.

**Course Outcome:**

At the end of the course, the student will be able to:

- CO1: Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould
- CO2: Centre the job and select the proper tool to perform the job on lathe machine.
- CO3: Calculate the taper angle and practice different taper turning methods on lathe.
- CO4: Prepare the edges for welding and select the suitable electrode, voltage and current.

**Cycle-I**

1. Moulding & casting of (i) Connecting rod (ii) Solid bearing (iii) V-Pulley/Gear Pulley
2. Arc welding (i) Lap Joint (ii) Butt Joint (iii) T- Joint
3. Gas welding (i) Lap Joint (ii) Butt Joint
4. Spot welding (i) Lap Joint
5. Turning Exercise (i) Facing, Step Turning & Chamfering (ii) Step Turning & Taper Turning

**Cycle -II**

1. Grinding the Lathe Cutting tools to the required angles
2. Study of Lathe, drilling machine, shaping machine and slotting machine
3. The dismantling some of the components of lathe and then assemble the same
4. List the faults associated with lathe and its remedies
5. The routine and preventive maintenance procedure for lathe.

**Reference Books:**

1. Elements of Workshop Technology (Volume I & II) – Hajra Chowdry & Bhattacharaya, Media Promoters, 11th Edition, 2007
2. Introduction of Basic Manufacturing Processes and Workshop Technology-Rajender singh, New age International (P) Ltd. New Delhi, 2006
3. Workshop Technology – Raghuwanshi, Khanna Publishers. Jain &Gupta, New Delhi, 2002.
4. Production Technology – Jain & Gupta, Khanna Publishers, New Delhi, 2006.
5. Production Technology – HMT, 18th edition, Tata McGraw Hill, New Delhi
6. Manufacturing process – Myro N Begman, 5 th edition, Tata McGraw Hill, New Delhi.

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Course Code	:	
Course Title	:	Automotive Engines
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- The main objective of this course is to impart knowledge in automotive engine. The detailed concept, construction and principle of operation of engine and various engine components, combustion, cooling and lubrication systems will be taught to the students. At the end of the course the students will have command over automotive engines and the recent development in the area of engines.

**Course Outcomes:**

At the end of the course, the student will be able to:

- Understanding of the basic working principles of engines, its Construction and Operation, phenomena of Combustion.
- Design of Combustion Chambers, Engine Testing and Performance and Performance characteristics.

**Course Content:**

**Units-I:**

**ENGINE BASIC THEORY:**

Engine types according to cycle, fuel, stroke, construction, operation, load condition and speed - Engine nomenclature, parts and its working – Two and four stroke engines - performance parameters for automobile engines- bore, stroke, volumetric efficiency, mean effective pressure, indicated power, break horse power, mechanical efficiency, thermal efficiency, overall efficiency two stroke engine - performance and pollution aspects.

**Units-II:**

**FUEL SUPPLY AND IGNITION SYSTEMS**

Theory of carburetion and carburetors, Diesel fuel injection - pumps and injectors, Introduction to Petrol Injection system - conventional ignition systems,

**COOLING AND LUBRICATING SYSTEMS**

Air cooling and water cooling – thermo syphon cooling, forced cooling systems. Fins and radiator -design aspects. Theory of lubrication — types of lubrication, splash lubrication system, petrol lubrication system, forced feed lubrication system.

**Unit-III:**

**AIR, FUEL, COMBUSTION AND COMBUSTION CHAMBERS**

Air fuel mixture- lean mixture, rich mixture, stoichiometric mixture, Octane number Ceten number complete combustion, pre ignition, ignition delay, diffused combustion, laminar and turbulent combustion of fuels in engines. combustion in SI and CI engines. Cylinder pressure data and heat release analysis. Optimized design of combustion chambers. Supercharger and Turbochargers.

**Unit-IV:**

**NEW ENGINE TECHNOLOGY**

Lean Burn engine – Different approaches to lean burn – LHR engine – EGR, catalytic ignition – homogenous charge compression ignition – variable valve timing – Multi Port Injection System - Gasoline Direct Injection – Common Rail Direct Injection – Recent Trends.

**Reference Books:**

1. J.B.Heywood, Internal combustion engine Fundamentals’, McGraw Hill Book Co, 1989.
2. V.Ganesan, Internal combustion Engines’, Tata McGraw Hill Book Co, Eighth Reprint.



Course Code	:	
Course Title	:	Strength of Materials
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	Engineering Mechanics (ESC201)
Course Category	:	PC

**Course Objectives:**

- To understand the concept of Simple Stresses and Strains.
- To understand the concept of Strain Energy.
- To understand the concept of Shear Force and Bending Moment Diagrams.
- To understand the concept of Theory of Simple Bending and Deflection of Beams.
- To understand the concept of Torsion in Shafts and Springs.
- To understand the concept of Thin Cylindrical Shells.

**Course outcomes:**

At the end of the course, the student will be able to:

CO1: Compute stress and strain values and find the changes in axial, lateral and volumetric dimensions of bodies of uniform section and of composite section under the influence of normal forces.

CO2: Compute shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of for UDL and Point loads.

CO3: Calculate the safe load, safe span and dimensions of cross section.

CO4: Compare strength and weight of solid and hollow shafts of the same length and material and compute the stress and deflection of the closed coil helical spring.

**Course content**

**UNIT-I: Simple Stresses and Strains:** Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for Mild Steel; Significance of factor of safety; Relation between elastic constants; Thermal stresses in bodies of uniform section and composite sections; Related numerical problems on the above topics.

**Strain Energy:** Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/ shock load; Related numerical problems.

**UNIT-II: Shear Force & Bending Moment Diagrams:** Shear Force & Bending Moment Diagrams: Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam ;Types of Loads–Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

**UNIT-III: Theory of Simple Bending and Deflection of Beams:** Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation  $M/I = \sigma/Y = E/R$  without derivation; Problems involving calculations of bending stress, modulus of section and moment of

resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

**UNIT-IV: Torsion in Shafts and Springs:** Definition and function of shaft; Calculation of polar M.I .for solid and hollow shafts; Assumptions in simple torsion; Torsion equation  $T/J = f_s/R = G\theta/L$  without derivation; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

**Thin Cylindrical Shells:** Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.

**Reference Books:**

1. Strength of Materials – D.S. Bedi, Khanna Book Publishing Co. (P) Ltd., Delhi, 2017
2. Strength of Materials – B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Laxmi Publications, New Delhi, 2013
3. Strength of Materials – S. Ramamrutham, Dhanpat Rai & Publication New Delhi
4. Strength of Materials – R.S. Khurmi, S.Chand Company Ltd. Delhi
5. A Text Book strength of Material– R.K. Bansal, Laxmi Publication New Delhi

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Course Code	:	
Course Title	:	Automotive Transmission Systems
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To study the concept of transmission system.
- To study the concept of Torque converter.
- To study the concept of Gear boxes.
- To study the concept of Hydrostatic and Electric Drive.

**Course outcomes:**

At the end of the course, the student will be able to:

- To understand the concept of transmission system.
- To understand the concept of Torque converter.
- To understand the concept of Gear boxes.
- To understand the concept of Hydrostatic and Electric Drive.

**Course content**

**UNIT-I:**

CLUTCH AND GEAR BOX Requirement of transmission system, Different types of clutches, principle & Construction of Single plate coil spring and Diaphragm spring clutches., Need and Objectives of Gear box. Construction and operation of Sliding mesh, Constant mesh and Synchromesh gearboxes. – Determination of gear ratios for vehicles. Performance characteristics in different speeds.

**UNIT-II:**

HYDRODYNAMIC TRANSMISSION Fluid coupling-Principle-Constructional details. Torque capacity. Performance characteristics. Reduction of drag torque in fluid coupling. Torque converter-Principle-constructional details, performance characteristics. Multistage torque converters and Polyphase torque converters. FWD,RWD,AWD,4X4 DIVING MODES

**UNIT-III:**

EPICYCLIC GEARBOXES USED IN AUTOMATIC TRANSMISSION Principle of Planetary gear trains - Wilson Gear box, electromagnetic transmission, Hydraulic control system for Automatic Transmission. Need for automatic transmission, Four speed longitudinally mounted automatic transmission Continuously Variable Transmission (CVT) – Types – Operations of a typical CVT.

**UNIT-IV:**

HYDROSTATIC AND ELECTRIC DRIVE Hydrostatic drive; various types of hydrostatic systems – Principles of Hydrostatic drive system. Advantages and limitations. Comparison of hydrostatic drive with hydrodynamic drive, construction and working of typical hydrostatic drive. Electric drive-types- Principle of early and modified Ward Leonard Control system-Advantages & limitations.

**Reference Books:**

1. Automotive Power Transmission Systems by Yi Zhang, Chris Mi; Wiley; 1st edition (31 August 2018)
2. Automotive Power Transmission Systems D S Bormane, V M Sardar. RN Chavan, Nirali Prakashan.
3. Automotive Transmission and Power train construction by W.H Crouse, D.L. Anglin; TMH.

Course Code	:	
Course Title	:	Alternate fuel and energy systems
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the concept energy need and role of alternate fuels
- To study the applications and methods of utilization of alternate fuels.
- To study the concept of hydrogen fuel cell and its application.

**Course outcomes:**

- Student will be able to understand the concept energy need and role of alternate fuels
- Student will be able to understand the applications and methods of utilization of alternate fuels.
- Student will be able to understand the concept of hydrogen fuel cell and its application.

**Course content**

**UNIT-I:**

Need for Alternative Fuels: Effects of constituents of Exhaust gas emission on environmental condition of earth (N<sub>2</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, SO<sub>2</sub>, O<sub>2</sub>) Pollution created by Exhaust gas emission in atmosphere. Green house effect, Factors affecting green house effect. Study of Global Carbon Budget, Carbon foot print and Carbon credit calculations. Emission norms as per Bharat Standard up to BS – IV and procedures for confirmation on production.

**UNIT-II:**

Bio Diesels: Base materials used for production of Bio Diesel (Karanji oil, Neemoil, Sunflower oil, Soyabean oil, Musturd oil, Palm oil, Jatropha seeds). Process of separation of Bio Diesel. Properties Diesel blended with vegetable oil, and difference in performance of Engine. Alcohol: Sources of Methanol and Ethanol, methods of it's production. Properties of methanol & ethanol as engine fuels, Use of alcohols in S.I. and C.I. engines, performance of blending methanol with gasoline. Emulsification of alcohol and diesel. Dual fuel systems. Improvement / Change in emission characteristics with respect to % blending of Alcohol.

**UNIT-III:**

Hydrogen: Hydrogen as a substitute fuel. Study Properties, Sources and methods of Production of Hydrogen, Storage and Transportation of hydrogen. Also, the economics of Application and Advantages of hydrogen (Liquid hydrogen) as fuel for IC engine/ hydrogen car. Layout of a hydrogen car. Fuel Cells: Concept of fuel cells based on usage of Hydrogen and Methanol. Power rating, and performance. Heat dissipation, Layout of fuel cell vehicle.

**UNIT-IV:**

Introduction to Biogas system, Process during gas formation, Factors affecting biogas formation. Usage of Biogas in SI engine & CI engine. LPG & CNG: Properties of LPG & CNG as engine fuels, fuel metering systems, combustion characteristics, effect on performance, emission, cost and safety. Synthetic Alternative Fuels: Di-Methyl Ether (DME), P-Series, Eco Friendly Plastic fuels (EPF).

**Reference Books:**

1. alternative fuels and advanced vehicle technologies venkateswarlu. k., murthy, b.s.r. phi
2. Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance: Towards Zero Carbon Transportation Richard Folkson woodhead Publications,

Course Code	:	
Course Title	:	Modern Vehicle Technologies
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the advancements in engines, suspension and brake systems
- To study the modern fuel injection and pollution control
- To study Comfort and convenience and modern luxury features.
- To study application of electronics IOT and AI in Automobile Engineering

**Course outcomes:**

- students will be able to understand the advancements in engines, suspension and brake systems
- students will be able to understand the modern fuel injection and pollution control
- Students will be able to understand Comfort and convenience and modern luxury features.
- students will be able to understand application of electronics IOT and AI in Automobile Engineering

**Course content**

**UNIT-I:**

**Advances In Engines, Suspension And Brake Systems** Advances in Automotive Power Plants: Hybrid Vehicles - Stratified charged / lean burn engines Hydrogen Engines Electric vehicles- Magnetic track vehicles solar powered vehicle Combined power source vehicle. Interconnected air and liquid suspensions, Hydromantic suspension system, Hydra gas suspension, modern rear wheel brake, indirect floating caliper disc brake, self energizing disc brake, brake limiting device, anti-slide system, Closed loop suspension; Regenerative braking.

**UNIT-II:**

**Modern Fuel Injection And Pollution Control** Modern fuel Injection systems - SPFI, MPFI, DI, Pilot Injection, Unit Injection, CRDI, Digital twin spark technology, variable valve timing (VVT), Camless Engine, GDi. Engine emissions, types of catalytic conversion, EGR, Evaporative emissions.

**UNIT-III:**

**Comfort and convenience**

Internal and External Noise, Identification of Noise sources, Noise Control Techniques. Computer Control for noise pollution, ambient lighting, Climate control, ventilated sheet, auto AC, 5 way adjustable seat, tilt adjustable Steering , power mirror adjustment, , Tail Gate opening system, , rain sensor system, environment information system, autonomous parking system, follow me home system, , sun roof, panoramic sun roof system.

**UNIT-IV:**

**AUOTMOTIVE ELECTRONICS** Types of sensors based on principle. Applications of sensors such as throttle position, mass air flow, crank shaft position, cam position, engine and wheel speed, steering position, tire pressure, brake pressure, steering torque, fuel level, crash, exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure sensors. Components for electronic engine management system, open and closed loop control strategies, PID control,

**Reference Books:**

1. K.K. Ramalingam, "Automobile Engineering". Scitech Publications Pvt. Ltd., 2005
2. Dr. N.K. Giri, "Automobile Mechanic" Khanna Publishers, 2006
3. Crouse/Anglin "Automotive Mechanics

Course Code	:	
Course Title	:	Vehicle Body Engineering
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the concept of Car Body Details & Types.
- To study the concept of Vehicle Aerodynamics.
- To study the concept of Commercial Vehicle Details & Types Of Body.
- To study the concept of Body Materials, Trim and Mechanisms.
- To study different techniques of automobile body repair maintenance and restoration

**Course outcomes:**

- Students will be able to understand the concept of Car Body Details & Types.
- Students will be able to understand the concept of Vehicle Aerodynamics.
- Students will be able to understand the concept Commercial Vehicle Details & Types Of Body.
- Students will be able to understand the concept of Body Materials, Trim and Mechanisms.

**Course content**

**UNIT-I:**

**Car Body Details & Types:** Saloon, convertibles, Limousine, Estate Van, racing and sports car. Visibility: regulations, driver's visibility, tests for visibility - Methods of improving visibility Safety: safety design, safety equipments for car. Various body panels and Construction of Car body.

**UNIT-II:**

**Vehicle Aerodynamics** - 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

**Bus Body Details:** Minibus, single decker, double decker, two level, split level and articulated bus. Bus body lay out - Floor height - Engine location - Entrance and exit location. Constructional details: Types of metal sections used - Regulations - Conventional and Integral type construction.

**UNIT-III:**

**Commercial Vehicle Details & Types Of Body** - Flat platform, drop side, fixed side, tipper body, tanker body. Light commercial vehicle body types. Dimensions of driver's seat in relation to controls - Drivers cab design

**UNIT-IV:**

**Body Materials, Trim and Mechanisms** Steel sheet, timber, plastics, GRP, properties of materials. Corrosion - Anticorrosion methods - Selection of paint and painting process Body trim items - Body mechanisms.

**Reference Books:**

4. Powloski J. Vehicle Body Engineering, Business Books Ltd., 1989.
5. Giles J.C. Body construction and design, Life books Butterworth & Co., 1971
6. John Fenton, Vehicle Body layout and analysis, Mechanical Engg. Publication Ltd. London, 1982K. Newton, W.Steeds "The Motor Vehicle"
7. J.B., Vehicle Body building and drawing, Heinemann Educational Books Ltd., London, 1977.

Course Code	:	
Course Title	:	ELECTRICAL VEHICLES
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

**Course Objectives:**

- To understand the basics of electric vehicle history and components.
- To understand properties of batteries.
- To understand the electrical machine properties and classifications.
- To understand the properties of electric vehicle drive systems
- To understand the concepts of hybrid electric vehicles.

**Course Outcomes**

At the end of the course, the student will be able to:

- CO1: Understand the basics of electrical vehicle history and components.  
CO2: Understand the properties of batteries.  
CO3: Understand the electrical machine properties and classifications.  
CO4: Understand the properties of electrical vehicle drive systems.

**Course Content:**

**UNIT-I: Electric Vehicles:** Introduction; History of Hybrid and Electric Vehicles; Evolution of Electric vehicles Advanced Electric drive vehicle technology Vehicles-Electric vehicles (EV), Hybrid Electric drive (HEV), Plug in Electric vehicle (PIEV), Social and Environmental importance of Hybrid and Electric Vehicles; Components, Vehicle kinetics, Dynamics of vehicle motion; Propulsion System layout.

**UNIT-II: Electric Vehicle Dynamics & Drive Train:** General description of vehicle movement Factors affecting vehicle motion- Vehicle resistance, tyre ground adhesion, rolling resistance, aerodynamic drag, Transmission configuration; Components: Gears, Brakes; Regenerative braking, Motor sizing; Fuel efficiency analysis. Hybrid Electric Vehicles drive train Parallel and Series configurations; Range extender, Electronic control unit ECU Schematics of hybrid drive train, control architecture.

**UNIT-III: DC & AC Electrical Machines:** Motor and Engine parameters; Classification of motors, EV Requirements; DC Series Motor, Brushless DC Motor, Permanent Magnet Synchronous Motor (PMSM), Three Phase AC Induction Motors, Switched Reluctance Motors (SRM), Synchronous SRM. Basic architecture of hybrid drive trains, types of HEVs Energy saving potential of hybrid drive trains HEV Configurations-Series, parallel, Series-parallel, complex.

**UNIT-IV: Battery:** Types; Lead-acid, Nickel metal hydride, Lithium-ion, Lithium- phosphates Parameters: Capacity, Discharge rate, State of charge, State of Discharge,Depth of Discharge; types of batteries Battery Charging Specifications of Battery pack, characteristics of Batteries. Super capacitors. Alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, flywheels Control system for EVs and HEVs, Regenerative braking in EVs.

**Reference Books:**

1. Electric & Hybrid Vehicles – A.K. Babu, Khanna Publishing House, New Delhi, 2018
2. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.
3. Electric Vehicle Technology Explained - James Larminie, John Wiley & Sons, 2003.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals - Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010.
5. Electric Vehicle Battery Systems - Sandeep Dhameja, Newnes, 2000

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Course Code	:	
Course Title	:	Automotive safety
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the Safety Concepts.
- To study the Safety Equipments.
- To study the Collision Warning And Avoidance.

**Course outcomes:**

- Students would be able to conceptualize the Safety Concepts.
- Students would be able to understand the Safety Equipment.
- Students would be able to understand the Collision Warning And Avoidance

**Course content**

**UNIT-I:**

**Introduction** Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction.

**UNIT-II:**

**Safety Concepts** Active safety: driving safety, conditional safety, perceptibility safety, operating safety passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact. Collision test procedure, safety rating, Off-roading and safety, water wading depth.

**UNIT-III:**

**Safety Equipments** Seat belt, regulations, automatic seat belt lightener system, seat belt reminder collapsible steering column, tilt able steering wheel, air bags, curtain air bags electronic system for activating air bags, bumper design for safety, Skid plate, seed sensing auto door lock, hill start assist, , hill assist, child iso fix, day night IRVM, lumbar support central locking system tyre pressure monitoring and control system fog lamp, rear defogger, soround view camera & sensors

**UNIT-IV:**

**Collision Warning And Avoidance** Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system Interactions. Cruz control, adaptive Cruz control, ADAS, EBD, Electronic stability control. locking deferential, brake locking differential, roll cage. Break assist, traction control

**Reference Books:**

Automotive Safety Handbook – Lothar Wech, Ulrich Seiffert

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Course Code	:	
Course Title	:	Automotive Air Conditioning
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the concept of Basic air conditioning system.
- To study the concept automotive air conditioning.
- To study the concept of Automatic climate control.

**Course outcomes:**

- Student will be able to understand the concept of Basic air conditioning system.
- Student will be able to understand the concept the concept automotive air conditioning.
- Student will be able to understand the concept of Automatic climate control.

**Course content**

**UNIT-I:**

Air conditioning Fundamentals Basic air conditioning system - Location of air conditioning components in a car - Schematic layout of a refrigeration system. Compressor components - Condenser and high pressure service ports.

**UNIT-II:**

Thermostatic expansion valve-Expansion valve calibration - Controlling evaporator temperature - Evaporator pressure regulator - Evaporator temperature regulator. Air Conditioning - Heating System Automotive heaters - Manually controlled air conditioner - Heater system - Ford automatically controlled air conditioner and heater systems.

**UNIT-III:**

Automatic temperature control - Air conditioning protection - Engine protection. Refrigerant 6 Hours Containers - Handling refrigerants - Tapping into the refrigerant container - Refrigeration system diagnosis - Diagnostic procedure - Ambient conditions affecting system pressures

**UNIT-IV:**

Air Routing & Temperature Control 12 Hours Objectives - Evaporator care air flow through the dash recirculating unit - Automatic temperature control - Duct system - Controlling flow - Vacuum reserve - Testing the air control and handling systems.

**Reference Books:**

1. William H Crouse and Donald L Anglin, Automotive Air conditioning, McGraw Hill Inc, 1990
2. Mitchell Information Services, Inc, Mitchell Automatic Heating and Air conditioning systems. Prentice Hall Inc, 1989.
3. Paul Weisler, Automotive Air Conditioning, Reston Publishing Co Inc., 1990.
4. MacDonald, K.L., Automotive Air Conditioning. Theodore Audel series. 1978.
5. Goings. LF., Automotive Air Conditioning, American Technical Services, 1974.

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Course Code	:	
Course Title	:	Automotive Engine and Vehicle Components Lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To provide the knowledge of petrol engine assembling and disassembling

**Course Outcomes:**

At the end of the course, the student will be able to:

- Understand the engine and its components in detail.
- Able to perform the assembling and disassembling of engines.

**Cycle I**

1. Dismantling of 4-cylinder petrol engine.
2. Assembling of 4-cylinder petrol engine.
3. Dismantling and assembling of 4-cylinder Engine Head.
4. Dismantling, inspection and assembling of any one type steering gearbox.
5. Dismantling, inspection and assembling of mechanical braking system.
6. Dismantling and assembling of Suspension system.

**Cycle II**

**Study, dismantling and assembling of**

7. Dismantling, inspection and assembling of Clutch assembly.
8. Dismantling, inspection and assembling of Gear box.
9. Dismantling, inspection and assembling of Front Axle.
10. Dismantling, inspection and assembling of Rear Axle.
11. Dismantling, inspection and assembling Differential Unit.
12. Study of vehicle cooling and lubrication system.

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Course Code	:	
Course Title	:	Automotive Engineering CAD/CAM Lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To learn to generate part models assembly of various machine components and systems using modeling packages
- To generate part and assembly models of actual Mechanical Products.

**Course Outcomes:**

At the end of the course, the student will be able to:

- Generate solid models and 2-D drawings of products
- Generate part models assembly of various machine components and systems
- Generate solid models and 3-D drawing for various components

**Cycle I**

1. Introduction to the software and creating 2D – Drawings
2. Introduction to 3d modelling
3. Drawing of crankshaft and development of short and long crank arms
4. Drawing of connecting rod small end and big end, shank design, design of big and cap bolts and drawing of the connecting rod assembly.

**Drawing of piston, piston pin and piston rings  
Cycle II  
Study, dismantling and assembling of**

5. Drawing of the inlet and exhaust valves
6. Drawing of Cam and Camshaft
7. Clutch: Components and assembly drawing using CAD Software
8. Helical spring design
9. Tension Spring design Leaf Spring design

**Reference Books:**

1. Hirz Mario , Wilhelm Dietrich, Integrated Computer-Aided Design in Automotive Development, Springer; 2013 edition.
2. O. Ostrowsky, Engineering Drawing with CAD Applications, Routledge; 1 edition.

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Course Code	:	
Course Title	:	Automotive Engine Testing and Pollution Control Lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To learn the various performance characteristics of both petrol and diesel engines
- To learn the various Pollution Measurement Devices

**Course Outcomes:**

At the end of the course, the student will be able to:

- Identify different areas of automobile pollution and control.
- Can find the applications of all the areas in day to day life.

**Cycle I**

1. Study of Pressure pickups, charge amplifier, storage oscilloscope and signal analysers used for IC engine testing
2. Performance study of petrol and diesel engines both at fullload and part load conditions
3. Morse test on petrol and diesel engines
4. Determination of compression ratio, volumetric efficiency and optimum cooling water flow rate in engines.
5. Testing of 2 and 4 wheelers using chassis dynamometers

**Cycle II**

6. Heat balance test on an automotive engine
7. Study of NDIR Gas Analyser and FID
8. Study of Chemiluminescent NOx analyzer
9. Measurement of HC, CO, CO<sub>2</sub>, O<sub>2</sub> using exhaust gas analyzer
10. Diesel smoke measurement

**Reference Books:**

1. Giles. J.G., Vehicle Operation and performance, Illiffe Books Ltd., London, 1989.
2. Crouse. W.H. and Anglin. D.L., Motor Vehicle Inspection, McGraw Hill Book Co., 1978.
3. Ganesan. V., Internal Combustion engines, Tata McGraw Hill Co.

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Semester-V							
Sl. No	Category	Course Title	Hours per week			Total contact hrs/week	Credits
			L	T	P		
1	Program core course	Troubleshooting and Maintenance of automobile	2	1	0	3	3
2	Program core course	Vehicle Dynamics	3	0	0	3	3
3	Program Elective course	Program elective 1	3	0	0	3	3
4	Program Elective course	Program elective 2	3	0	0	3	3
5	Open Elective	Open elective	3	0	0	3	3
7	Program core course	Troubleshooting and Maintenance of automobile Lab	0	0	2	2	1
8	Summer Internship-II (6 weeks) after 4 <sup>th</sup> Semester	Summer Internship-II	0	0	0	0	3
9	Major Project		0	0	2	2	^
						Total	19

**Program elective 1**

1. Transport management
2. Total quality management
3. Industrial engineering and management

**Program elective 2**

1. Tractor and Farm Equipment
2. Heavy Vehicles
3. Off road Vehicles

**Open elective**

1. Energy efficiency and audit
2. Product Design
3. Operation Research

Semester-VI							
Sl. No	Category	Course Title	Hours per week			Total contact hrs	Credits
			L	T	P		
1	Program core course	Design of Machine Elements	2	1	0	3	3
2	Program core course	Automotive Pollution and Control	3	0	0	3	3
3	Humanities and Social Science course	Entrepreneurship and Start-ups	3	0	0	3	3
4	Open Elective course-2 (OE2)	Open Elective course-2	3	0	0	3	3
5	Open Elective course-3 (OE3)	Open Elective course-3	3	0	0	3	3
6	Mandatory Course	Indian Constitution	2	0	0	2	0
7	Major Project		0	0	6	6	4
8	Seminar		1	0	0	1	1
						<b>Total</b>	<b>20</b>

**Open Elective – 2:**

1. 3D Printing
2. Project Management
3. Mechatronics

**Open Elective – 3:**

1. Energy Conservation and Audit
2. Renewable Energy Technologies
3. Robotics

Course Code	:	
Course Title	:	Troubleshooting and Maintenance of Automobile
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To understand the automobile maintenance
- Understanding and doing idling adjustment
- Understanding and doing the timing adjustment
- Understanding the Construction and working of braking system

**Course outcomes:**

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

- Identify the tools and gauges required
- dismantling and assembling
- Fault finding and rectification of different troubles
- Servicing and adjustments.
- Calculate the cooling load of air conditioning systems and cooling towers.

**Course content**

**UNIT-I:**

**General procedure for servicing and maintenance of motor vehicles**

Types of maintenance – Periodic maintenance – Preventive maintenance– breakdown maintenance – Operation maintenance – Servicing, QuickService and its necessity – Cleaning of the motor vehicle components -Greasing of motor vehicle – Lubrication of springs - Engine tune-up

**UNIT-II:**

**Service Station**

Garage, Service Station, Specialist repair Shop – Tools and equipment for a garage and service station – factors to be considered while locating service station – layout of a typical garage and service station.

**Automobile Service Station Equipment**

Car Washing Equipment - Vehicle Hoist - Air Compressor - Lubrication equipment – Grease guns – High pressure lubrication

**UNIT-III:**

**Servicing & Maintenance of Two & four wheelers**

General maintenance - periodic checkup and the trouble shooting of motor cycle.

**Engine systems:** - Fuel system - General diagnosis and fault rectification in fuel system (Carbureted system and fuel injection system) Lubrication system -Diagnosis and fault rectification in Cooling system. Ignition system :-Diagnosis and fault rectification of Battery, Ignition Magneto system and Electronic Ignition system

Transmission system: - Diagnosis and fault rectification in clutch, gearbox, differential.



#### **UNIT-IV:**

##### **Automobile Engine reconditioning Equipment**

Degreasing plant – Procedure of degreasing – De-carbonizing methods –working of reconditioning equipment – cylinder reboring machine, honing machine, line boring machine, valve seat cutting and grinding machine, valve refacing machine, valve lapping, crank shaft grinding machine, brake drum lathe, brake shoe riveting machine.

##### **Reconditioning of Diesel Fuel injection system**

Fuel injection pump Test Bench - Phasing and Calibration of F.I.P.- Servicing and Testing of Fuel injector - Trouble shooting of fuel injection system.

#### **Reference Books:**

1. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnick.
2. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal, Jayesh P.Maniar. 2014

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Course Code	:	
Course Title	:	Vehicle Dynamics
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- To understand the Vehicle Dynamics and understanding vehicle stability.
- To understand aerodynamics and to impart knowledge on aerodynamic shape in automobile in order to increase fuel efficiency.
- To estimate tractive effort required to propel the vehicle & parameters of vehicle performance.
- To understand rolling and gradient resistance

**Course Outcomes:**

- Identify the principles of vehicle dynamics
- Effect of air resistance and understand the concepts of aerodynamics.
- Fault finding and rectification of different troubles
- Calculate various forces & moments acting on moving vehicles.
- Servicing and adjustments.

**UNIT-I**

**Fundamentals to vibration**

Fundamentals of vibration, Mechanical vibrating system. Modeling & simulation. Model of an automobile-Single, two, multi degrees of freedom systems-Free, forced and damped vibration. Magnification factor-Transmissibility, Vibration absorber. Multi Degree of Freedom System: Closed coupled system, Eigenvalue problems, Far coupled system-Orthogonality of mode shapes- Modal analysis

**UNIT-II**

**Vehicle handling**

Oversteer, understeer, Steady state concerning. Effect of braking, driving torques on steering. Effect of chamber, transient effects in concerning. Directional stability of vehicles, condition for true rolling.

**Stability of vehicles** Load distribution. Calculation of tractive effort and reactions for different drives stability of a vehicle on a slope, on a curve and a banked road, power of propulsion, road performance curve and its applications (acceleration, gradeability, drawbar pull)

**UNIT-III**

**Riding Comfort**

Spring mass frequency. Wheel hop, wheel wobble, wheel shimmy. Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft directions.

**Braking**

Effect of braking, types of braking techniques, effect of CG and its location on brake dynamics.

**UNIT-IV**

**Tires**

Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire. Ride property of tires. Magic formulae tire model, Estimation of tire road friction. Test on various road surfaces. Tire vibration. Ride characteristics of tires, behaviors while cornering, power consumed by tires.

**Reference Books:**

1. John. D Anderson, Jr. Fundamentals of aerodynamics, McGraw-Hill Books Company
2. Wolf-Heinrich Hucho, Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering, Elsevier, 2013
3. Richard stone, Jeffrey k. Ball, Automotive Eng. Fundamentals, SAE International
4. John Fenton, Vehicle body layout and analysis, Hutchinson, London

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Course Code	:	
Course Title	:	Transport Management
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the Personnel management.
- To study Transport Systems
- To study Motor Vehicle Act

**Course Outcomes:**

- Students will be able to understand the Personnel management.
- Students will be able to understand Transport Systems
- Students will be able to understand Motor Vehicle Act

**UNIT-I**

**Introduction Personnel management;** objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

**UNIT-II**

**Transport Systems** Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. Chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

**UNIT-III**

Scheduling and Fare Structure Principal Features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

**UNIT-IV**

**Motor Vehicle Act** Traffic signs, fitness certificate, registration requirements, permit insurance, constructional regulations, description of vehicle-tankers, tippers, delivery vans, recovery vans, power wagons and fire fighting vehicles. Spread over, running time, test for competence to drive. Fleet Maintenance and depot layout Preventive maintenance system in transport industry, tyre maintenance procedures. Causes for uneven tyre wear, remedies, maintenance procedure for better fuel economy, design of bus depot layout.

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Course Code	:	
Course Title	:	Total Quality Management
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the Personnel management.
- To study Transport Systems
- To study Motor Vehicle Act

**Course Outcomes:**

- Students will be able to understand the Personnel management.
- Students will be able to understand Transport Systems
- Students will be able to understand Motor Vehicle Act

**UNIT-I**

An Overview: Quality Definition. Quality. Price, Value Relationship. Evolution in Quality Management - Inspection, Quality Control, Statistical Quality Control, Quality Assurance, Total Quality Management Thoughts/ Contribution of Quality Gurus.

**UNIT-II**

Deming's 14 Points, Deming PDCA Cycle, Juran's Trilogy, and Crosby's Zero Defect. Core Concepts of TOM: Top Management Leadership, Customer Orientation. Total Employee Involvement Continuous Process Improvement Supplier Partnership: Partnering, Sourcing. Selection, Certification, Relation development.

**UNIT-III**

Concept of Quality Control and Quality Improvement: Costs of Quality - Prevention, Appraisal Internal Failure, External Failure. Failure: Random and Assignable causes; Statistical Process Control Charts - X&R chart. p-chart, c-chart, Concept of process capability Acceptance Sampling and OC curve, Buyer risk and Supplier risk, Average Outgoing Quality Emphasis on small improvements - Kaizen, People participation Quality Circle, QC Tools (old) & 7 Tools (new). Conditions for Success of TOM.

**UNIT-IV**

Overview of some other initiatives of process improvement: Six Sigma, TPM, Lean Manufacturing Some tools for analysis: Quality Benchmarking, Quality Function Deployment (OFD), Failure Mode and Effect Analysis (FMEA) Quality Management Systems: Product vs Process Quality standard, ISO 9000 series of standards, ISO 9001 Requirements, Implementation, Documentation, Audits, and Registration; Benefits of ISO.

**Reference Books:**

1. Mukherjee - "Total Quality Management", PHI
2. Evans J.R. - "Total Quality Management", Cengage
3. Besterfield et al. - "Total Quality Management", Pearson
4. Gryna, Chua, & Defeo - "Quality Planning & Analysis for Enterprise Quality". TMH
5. Montgomery, - "Introduction to Statistical Quality Control", John Wiley & Sons

Course Code	:	
Course Title	:	Industrial Engineering & Management
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

**Course Objectives:**

- To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
- To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
- To use the Charts to record the Activities of the people, materials and Equipment to find alternative methods which minimize waste and to implement the best method.

**Course outcomes:**

At the end of the course, the student will be able to:

CO1: Explain the different types of layout and plant maintenance with safety CO2: List and explain the need of method study and work measurements CO3: Explain the production planning and quality control, and its functions

CO4: Understand the basic principles, approaches and functions of management and identify concepts to specific situations

**Course Content:**

**UNIT-I: Plant Engineering:** Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Material handling equipment; Maintenance and its types.

**Plant Safety:** Accident: Causes, and their preventions; Industrial disputes and Settlements; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

**UNIT-II: Work Study:** Productivity; Standard of living; Method of improving productivity; Objectives;

Need of good working conditions.

**Method Study:** Definition; Objectives; Selection of a job for method study; Basic procedure for conduct

of Method study; Tools used; Operation process chart; Flow process chart; String diagram and flow diagram.

**Work Measurement:** Definition; Basic procedure in making a time study; Employee's rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calculation of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study.

**UNIT-III: Production Planning and Control:** Introduction; Methods of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Controlling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Numerical problems.

**Material Management:** ABC analysis of Inventory; Procurement cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quantity problems; Supply Chain.

**Quality Control:** Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Quality Management System Registration/Certification procedure; Benefits of ISO to the organization.

**UNIT-IV: Principles of Management:** Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Types of Organization: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leadership; Styles of Leadership; Qualities of a good leader; Motivation and its types; Modern Management Techniques; Just In Time; 5S Concept; Management Information Systems.

**Personnel Management:** Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Objectives and Importance; Wages and Salary Administration; Job Evaluation and Merit Rating, its Objectives and Importance; Components of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan; Numerical Problems.

Reference Books:

1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co. (P) Ltd., Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Wehrich, Harold Koontz, 10th Edition, McGraw Hill International Edition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

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Course Code	:	
Course Title	:	Tractors and Farm Equipment
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

Course Objectives:

- To study the design of tractors
- To study the tractor controls and starting.
- To study the Farm equipment.

Course Outcomes:

- Students will be able to understand the components of Tractor.
- Students will be able to understand Tractor engine performance characteristics.
- Students will be able to understand Farm equipment.

**UNIT-I**

**Introduction**

General Design of Tractors: Classification of Tractors-Main components of Tractor-Safety Rules. Control of the Tractor and Fundamentals of Engine Operation: Tractor controls and the starting of the tractor engines.

**UNIT-II**

**Tractor Engine** Engine cycles-Operation of multicylinder engines of a tractor-additional changes made in a tractor engine design – tractor engine performance characteristics. Engine Frame Work and Valve Mechanism of Tractor: Cylinder and pistons-Connecting rods and crankshafts Engine balancing in tractors.

**UNIT-III**

**Auxiliary systems and equipments-** Cooling system, Lubrication System and Fuel System of a Tractor: hydraulic system – Components, Maintenance & Servicing of Hydraulic System in Tractor – Air cleaner and turbo charger – Fuel tanks and filters –Fuel pumps. Working attachment of tractors.

**UNIT-IV**

**Farm Equipments:** -Farm equipment – Classification – Auxiliary equipment – Trailers and body tipping mechanism. Lawnmovers, combine harvestors, Operation & Maintenance of Power Tiller. Operation and Maintenance of Sowing and Weeding Equipments. Plant Protection Equipments.

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Course Code	:	
Course Title	:	Heavy Vehicles
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study the functions of trucks.
- To study hydraulic system functions.
- To study Truck Chassis.

**Course Outcomes:**

- Students will be able to understand the functions of load trucks.
- Students will be able to understand Truck Chassis.
- Students will be able to understand different Earth moving machinery.

**UNIT-I**

Trucks: Classification of trucks, main truck assemblies, functions of load trucks, specifications of a truck, types of engine used, power requirement, multi axel trucks, applications of trucks, tippers, tankers and trailers, Basics trends in truck design, forces acting on a truck on move (both for empty and loaded condition), parallel pull and rolling resistance, truck stability and weight distribution.

**UNIT-II**

Hydraulic System Functions of hydraulic system, hydraulic components: pump, valves, solenoid valves, livers, actuators, telescopic actuators. Method of attaching implements, classification of hydraulic controls for hitches, integral hitch system, draft control system. Position control and Mixed control.

**UNIT-III**

Truck Chassis Salient features of engine, clutch, power transmission, final drive, brakes and steering of Indian trucks.

Truck Wheels and Tyres Salient features of wheels, tyres and wheel base/wheel tracks. Specifications of wheels and tyres, dual versus tendum tyres, tread design, effect of tyre inflation. Selection criteria of a truck, maintenance and operation of truck, differential lock

**UNIT-IV**

Earth Moving Machinery Description and working principles of: Bull Dozer, Leveler, Front end loader, Cranes, Scrapper, Repair and Maintenance Faults and their rectification in earth moving vehicles and maintenance of truck.

**Reference Books:**

1. Farm Machines and Equipment by CP Nakra; Dhapat Rai and Sons, New Delhi.
2. Manual of Tractors by J Konard, Asia Publishing House.
3. Tractors and Agriculture Equipment by Jain and Roy.

Course Code	:	
Course Title	:	Off Road Vehicles
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	
Course Category	:	PE

**Course Objectives:**

- To study different off-road vehicles.
- To study earth moving equipments.
- To study special purpose vehicles.

**Course Outcomes:**

- Students will be able to understand off-road vehicles.
- Students will be able to understand earth moving equipment.
- Students will be able to understand special purpose vehicles.

**UNIT-I**

**INTRODUCTION TO OFF-ROAD VEHICLES** Multi-axle vehicles. Heavy duty petrol engines and high speed diesel engines, air cooled and water cooled engines and air filters as in off highway vehicles. Performance characteristics of vehicles, resistance to digging and motion, tractive effort, power required, number of speeds and gear ratios desirable, double reduction arrangements. Bush cutter, stampers, Tree dozer, Rippers.

**UNIT-II**

**EARTH MOVING EQUIPMENTS** Earth Moving Machines: Bulldozers, cable and hydraulic dozers, Crawler track, running and steering gears, scrapers, drag and self powered types - Dump trucks and dumpers - Loaders, single bucket, multi bucket and rotary types. Scrapers, elevating graders, self powered scrapers and graders. Land Clearing Machines

**UNIT-III**

**SPECIAL PURPOSE VEHICLES** Shovels and Ditchers: Power shovel, revolving and stripper shovels - drag lines . ditchers Capacity of shovels. Construction & Industrial Equipments: Construction and operational aspects of mobile cranes, road rollers, elevators, Fork Lifters. Working attachment of tractors

**UNIT-IV**

Farm equipment Classification - Auxiliary equipment - Trailers and body tipping mechanism. Special features and constructional details of tankers, qun carriers and special transport vehicles, bullet proof vehicles, special materials for military uses Kevlar, fiberglass and carbon fiber Fiberforge.

**Reference Books:**

1. Abrosimov. K. Bran berg. A. and Katayer.K.." Road making Machinery " MIR Pub., Moscow, 1971
2. Wong.J.T., " Theory of Ground vehicles, John Wiley & Sons, New York, 1987.
3. B. Geleman and M. Moskovin, Farm tractors, MIR publishers, Moscow.
4. Astokhov, Truck Cranes, MIR Publishers, Moscow

Course Code	:	
Course Title	:	Energy Efficiency and Audit
Number of Credits	:	3 (L: 3, T: 0 P: 0)
Prerequisites	:	NIL
Course Category	:	OE

**Course Objectives:**

- The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:
- Undertake energy efficiency measures and energy audit.

**Course Outcomes:**

After Completing this Course, Students will be able to CO1: Undertake energy efficiency activities.

CO2: Use energy efficient pumps, compressors and blowers.

CO3: Use energy efficient Air Compressors and DG sets.

CO4: Use energy efficient Lighting Systems and Apply energy efficient electrical machines.

**Course Contents:**

**Unit-I: Introduction to Energy Efficiency:** Energy Scenario: Energy demand and supply, National scenario. Energy Efficiency and Energy Conservation; Indian Electricity Act 2001; relevant clauses of energy conservation, BEE and its Roles, Star Labelling: Need and its benefits.

**Pumping Systems, Fans and Blowers:** Factors affecting pump performance; Efficient Pumping; system operation Energy conservation opportunities in Pumping systems; Fan types, flow control strategies; Fan performance; Assessment Energy Conservation opportunities in Pumping systems; Tips for energy saving in fans and blowers.

**Unit-II: Air Compressors and Diesel Power Generator sets:** Classification of compressors; Pneumatic System components; Effect of various parameters on efficiency of Compressor; Checklist for Energy Efficiency in Compressed air systems; Operating guidelines for diesel generator, operational factors, Energy saving measures for DG sets.

**Energy Conservation in Lighting System:** Replacing Lamp sources using energy efficient luminaries; Using light-controlled gears Installation of separate transformer / servo stabilizer for lighting; Innovative measures of energy savings in lighting.

**Unit- III: Energy Efficient Electrical Machines:** Energy conservation techniques in Induction motor & Transformer; Energy efficient motor & their significant features, Aggregated Technical and commercial losses (ATC), Technical losses; causes and measures to reduce, Commercial losses: Application of tariff system to reduce energy bill; Co-generation and Tariff; concept, significance for energy conservation.

**Unit- IV: Energy Audit of Electrical Systems:** Energy audit (definition as per Energy Conservation Act); Energy audit instruments and their use; Questionnaire for energy audit projects; Energy flow diagram (Sankey diagram); Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.

**References:**

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and

- Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi, Edition 2018, (ISBN: 978- 93-86173-683).
  3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN: 978-0195606539.
  4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708.
  5. Sharma, K. V., Venkatasashaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298.
  6. Mehta ,V. K., Principles of Power System, S. Chand andCo.New Delhi, 2016, ISBN 9788121905947.
  7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K KatariaandSons,New Delhi ISBN13: 9789350141014.
  8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt.Ltd.
  9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition.

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Course Code	:	
Course Title	:	PRODUCT DESIGN
Number of Credits	:	3 (L: 3, T: 0 P: 0)
Prerequisites	:	NIL
Course Category	:	OE

#### Course Learning Objectives:

- To acquire the basic concepts of product design and development process.
- To understand the engineering and scientific process in executing a design from concept to finished product.
- To study the key reasons for design or redesign.

#### Course outcomes:

At the end of the course, the student will be able to:

CO1: Understand the basic concepts of product design and development process. CO2: Illustrate the methods to define the customer needs

CO3: Understand the intuitive and advanced methods used to develop and evaluate a concept. CO4: Apply modelling and embodiment principles in product design and development process.

#### Course Content:

**UNIT-I:** Definition of a product; Types of products; Levels of product; Product-market mix; New product development (NPD) process; Idea generation methods; Creativity; Creative attitude; Creative design process; Morphological analysis; Analysis of interconnected decision areas; Brain storming

**UNIT-II:** Product life cycle; The challenges of Product development; Product analysis; Product characteristics; Economic considerations; Production and Marketing aspects; Characteristics of successful Product development; Phases of a generic product development process; Customer need identification; Product development practices and industry-product strategies.

**UNIT-III:** Product design; Design by evolution; Design by innovation; Design by imitation; Factors affecting product design; Standards of performance and environmental factors; Decision making and iteration; Morphology of design (different phases); Role of aesthetics in design.

**UNIT-IV:** Introduction to optimization in design; Economic factors in design; Design for safety and reliability; Role of computers in design; Modeling and Simulation; The role of models in engineering design; Concurrent design; Six sigma and design for six sigma; Introduction to optimization in design; Economic factors and financial feasibility in design; Rapid Prototyping (RP); Application of RP in product design; Product Development versus Design.

#### Reference Books:

1. Product Design and Development, Karl T. Ulrich and Steven D. Eppinger, Tata McGraw–Hill edition.
2. Engineering Design –George E. Dieter. McGraw Hill.
3. An Introduction to Engineering Design methods, Vijay Gupta. Tata McGraw Hill Publishers.
4. New Product management, Merie Crawford : McGraw-Hill Irwin.
5. Product Design and Manufacturing, Chitale A K and Gupta R C, Prentice Hall of India, 2005.
6. Product Design, Techniques in Reverse Engineering and New Product Development, Kevin Otto and Kristin Wood, Pearson education.

Course Code	:	
Course Title	:	OPERATIONS RESEARCH
Number of Credits	:	3 (L: 3, T: 0 P: 0)
Prerequisites	:	NIL
Course Category	:	OE

**Course Learning Objectives:**

- To understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.
- To acquire knowledge of formulating mathematical models for quantitative analysis of managerial

Course outcomes:

At the end of the course, the student will be able to:

CO1: Recognize the importance and value of Operations Research and mathematical modeling in solving practical problems in industry.

CO2: Understand and implement the Transportation Models and Assignment Models at work-place.

CO3: Understand and implement the Sequencing model at work-place.

CO4: Understand the characteristics of different types of decisions.

Course Content:

**UNIT-I: Introduction:** Definition, Characteristics and phase of Scientific Method, Types of models; General methods for solving operations research models.

Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.

**UNIT-II: Transportation Problem:** Formulation; Finding an Initial feasible solution, Optimal solution by stepping stone and MODI methods; Degeneracy; Unbalanced Transportation problems; **Assignment problem:** Formulation; Optimal solution, Hungarian method of Assignment Problems. Travelling salesman problem.

**UNIT-III: Sequencing:** Introduction; Terminology; Notations and Assumptions; Problems with n- jobs through 2 machines; Optimal sequence algorithm; Problems with n-jobs through three machines, Problems with n-jobs through m machines.

**UNIT-IV: Theory of games:** Introduction; Two-person zero-sum games; The Maximum–Minimax principle; Games without saddle points; Mixed Strategies; 2 x n and m x 2 Games; Graphical solutions; Dominance property.

Reference Books:

1. Operations Research: Principles and Applications - G.Srinivasan, PHI Learning Private Limited.
2. Operations Research: An Introduction - Hamdy A. Taha, Pearson.
3. Operations Research: Principles and Practice - Ravindran, Phillips and Solberg, Wiley India
4. Operations Research: Concepts and Cases - Hillier and Liberman, McGraw-Hill.
5. Operations Research – P SankarAiyer, McGraw-Hill.

Course Code	:	
Course Title	:	Troubleshooting and maintenance lab
Number of Credits	:	1 (L:0; T:0; P:2)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

- Understanding and doing idling adjustment
- Understanding and doing the timing adjustment
- Understanding the Construction and working of braking system

**Course Outcomes:**

At the end of the course, the student will be able to:

- Identify the tools and gauges required
- dismantling and assembling
- Fault finding and rectification of different troubles
- Servicing and adjustments.
- Calculate the cooling load of air conditioning systems and cooling towers.

**Cycle I**

**Servicing and Maintenance of various systems of an Automobile:**

1. Fuel system of Petrol engine & Diesel engine
2. Cooling system
3. Lubrication system
4. Starting system
5. Generating system
6. Ignition system

**Cycle II**

**Re-conditioning:**

1. Decarburization
2. Cylinder Re-boring & Cylinder Honing.
3. Valve seat cutting, grinding, re-facing and lapping.
4. Line boring
5. Brake drum turning & Brake shoe riveting
6. Driving practice on Motor vehicle

Course Code	:	
Course Title	:	DESIGN OF MACHINE ELEMENTS
Number of Credits	:	3 (L: 2, T: 1 P: 0)
Prerequisites	:	Engineering Mechanics Strength of Materials Theory of Machines & Mechanisms
Course Category	:	PC

**Course Objectives:**

- To enable the student to design and draw simple machine components used in small and medium scale industries.
- To understand the basic philosophy and fundamentals of Machine Design.
- To understand the modes of failures of m/c components and decide the design criteria and equations.
- To analyze and evaluate the loads, forces, stresses involved in components and subassemblies and decide the dimensions.
- To develop analytical abilities to give solutions to engineering design problems.

**Course outcomes:**

At the end of the course, the student will be able to:

CO1: Analyze the various modes of failure of machine components under different load patterns.

CO2: Design Simple Machine parts and Bearings. CO3: Design Shafts, Keys, Couplings and Spur Gear.

CO4: Design Screws, Springs and Understand the concept of Ergonomics.

**Course Content:**

**UNIT-I: Introduction to Design:** Machine Design philosophy and Procedures; General Considerations in Machine Design; Fundamentals: Types of loads, concepts of stress, Strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses; Bearing pressure Intensity; Crushing; Bending and Torsion; Principal Stresses; Simple Numericals; Factor of Safety and Factors governing selection of factor of Safety; Stress Concentration: Causes & Remedies; Designation of materials as per IS and introduction to International standards & advantages of standardization; Theories of Elastic Failures; Principal normal stress theory; Maximum shear stress theory & Maximum distortion energy theory.

**UNIT-II: Design of simple machine parts:** Cotter Joint; Knuckle Joint; Turnbuckle;  
**Antifriction Bearings:** Classification of Bearings; Design of Sliding contact & Rolling contact bearings; Terminology of Ball bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limiting speed; Selection of ball bearings using manufacturer's catalogue.

**UNIT-III: Design of Shaft, Keys, Couplings and Spur Gears:** Design of shaft for combined loading; Design of Sunk Keys; Design of Couplings – Muff Coupling, Protected type Flange Coupling;

Spur Gear: Design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.

**UNIT-IV: Design of Fasteners and Springs:** Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to eccentric loading;

**Design of springs:** Classification and Applications of Springs; Spring terminology; Materials and



Specifications; Stresses in springs; Wahl's correction factor; Deflection of springs; Energy stored in springs; Design of Helical, Tension and Compression springs subjected to uniform applied loads like I.C. engine valves, Weighing balance, Railway buffers and Governor springs; Leaf springs: Construction and Application; Ergonomics of Design.

**Reference Books:**

1. Machine Design – Sadhu Singh, Khanna Book Publishing Co., Delhi
2. Machine Design Data Book – Sadhu Singh, Revised Edition, Khanna Book Publishing Co., Delhi. (ISBN: 978-9382609-513)
3. Introduction to Machine Design – V.B.Bhandari, Tata Mc- Graw Hill, New Delhi.
4. Mechanical Engineering Design – Joseph Edward Shigley, Tata Mc- Graw Hill, New Delhi.
5. Machine design – Pandya & Shah, Dhanpat Rai & Son, New Delhi.
6. Machine design – R.K.Jain, Khanna Publication, New Delhi.
7. Design Data Book – PSG Coimbtore, PSG Coimbtore.
8. Hand Book of Properties of Engineering Materials & Design Data for Machine Elements – Abdulla Shariff, Dhanpat Rai & Sons, New Delhi.

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Course Code	:	
Course Title	:	Automotive pollution and control
Number of Credits	:	3 (L: 2, T: 1 P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

The objective of this course is

- To make the students to know and understand the principle of engine combustion and emission characteristics.
- To address the underlying concepts and methods behind automobile pollution and control.

**Course outcomes:**

- Understand the concepts of air pollution, its cause and health hazards.
- Learn the methods for reducing and controlling the pollutants.
- Understand the various techniques for controlling the exhaust emissions from engines.
- Know the various emission standard and the modern techniques for controlling air pollution.

**Course Content:**

**UNIT-I:**

**Introduction to automotive pollution**

The atmosphere, Air pollutants, Pollutants produced by automobiles, effects on human health and environment, global warming, Noise and sound pressure, Measurement of noise, Causes of automobile noise and its reduction.

**Principle of production of exhaust gases**

Theoretical air-fuel ratio, Carbon monoxide (CO), Hydro Carbon (HC), Oxides of Nitrogen (NOx), Driving conditions and exhaust gases

**UNIT-II:**

**Emission control systems**

Design strategies to control emission from engines, Emission control components layout and drawing, Necessity and operation of Positive Crankcase Ventilation (PCV) system, Necessity and operation of fuel evaporative emission control (EVAP) system for Carburetted & MPFI engines, Necessity and operation of Throttle Positioner (TP) system & Throttle Positioner sensor, Catalytic converters, Oxygen (O<sub>2</sub>) sensor, Necessity and operation of High Altitude Compensation (HAC) system, Manifold Absolute Pressure Sensor (MAPS), Spark timing emission control systems, Knock (Detonation) sensor, Exhaust gas re-circulation (EGR) system, Necessity and operation of Mixture Control

**UNIT-III:**

**Measurement Techniques Emission Standards and Test Procedure**

NDIR, FID, Chemiluminescent analyzers, Gas Chromatograph, smoke meters, Emission control norms- International & Indian norms. Test procedures – ECE, FTP Tests. SHED Test – chassis dynamometers.

**UNIT-IV: LPG and CNG conversion**

Merits of LPG's, LPG conversion kit, LPG kit installation, Maintenance of LPG kit components, Merits of CNG's, CNG conversion kit, CNG kit installation, Maintenance of CNG kit components, Performance features of Petrol, LPG and CNG.

**Reference Books:**

1. Paul Degobert, Automobiles and Pollution, SAE International ISBN-1-56091-563- 3,1991.
2. Ganesan, V- "Internal Combustion Engines"- Tata McGraw-Hill Co.- 2003.
3. Beranek.L.L. " Noise Reduction", McGraw Hill Book co., Inc, New York, 1993.
4. Mathur and Sharma's Internal Combustion Engines, Dhanpat Rai& sons- India
5. Internal combustion engine by domkundwar.

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Course Code	:	
Course Title	:	Entrepreneurship and start-ups
Number of Credits	:	3 (L: 2, T: 1 P: 0)
Prerequisites	:	
Course Category	:	PC

**Course Objectives:**

The objective of this course is

- Acquiring Entrepreneurial spirit and resourcefulness.
- Familiarization with various uses of human resources for earning dignified means of living.
- Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation
- Acquiring entrepreneurial quality, competency, and motivation.
- Learning the process and skills of creation and management of entrepreneurial venture

**Course outcomes:**

On completion of the study of the subject the student will be able to

- Understanding the dynamic role of entrepreneurship and small businesses
- Organizing and Managing a Small Business
- Financial Planning and Control
- Forms of Ownership for Small Business
- Strategic Marketing Planning
- New Product or Service Development
- Business Plan Creation

**Course Content:**

**UNIT-I:**

**Introduction to Entrepreneurship and Start – Ups:** Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation, Types of Business Structures, Similarities/differences between entrepreneurs and managers.

**UNIT-II:**

**Business Ideas and their implementation:** Discovering ideas and visualizing the business, Activitymap, Business Plan.

**UNIT-III:**

**Idea to Start-up:** Market Analysis – Identifying the target market, Competition evaluation and Strategy, Development. Marketing and accounting, Risk analysis, Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.

**UNIT-IV:**

**Management, and Financing & Protecting Ideas**

Company's Organization Structure, Recruitment and management of talent, Financial organization and management, Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses.

**Reference Books:**

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company SteveBlank and Bob Dorf K & S Ranch ISBN – 978-0984999392
2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses Eric Ries Penguin UK ISBN – 978-0670921607
3. Demand: Creating What People Love Before They Know They Want It Adrian J. Slywotzkywith Karl Weber Headline Book Publishing ISBN – 978-0755388974
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You DoBusiness Clayton M. Christensen Harvard business ISBN: 978-142219602

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Course Code	:	
Course Title	:	3-D Printing
Number of Credits	:	3 (L: 3, T: 0 P: 0)
Prerequisites	:	Computer Aided Design & Drafting
Course Category	:	OE

**Course Learning Objectives:**

- To gain knowledge and skills related to 3D printing technologies.
- To learn the selection of material, equipment and development to product for Industry 4.0 environment.
- To understand the various software tools, process and techniques for digital manufacturing.

**Course outcomes:**

At the end of the course, the student will be able to:

CO1: Develop CAD models for 3-D printing. Import and Export CAD data and generate .stl file.

CO2: Select a specific material for the given application. CO3: Select a 3-D printing process for an application.

CO4: Produce a product using 3-D Printing or Additive Manufacturing (AM).

**Course Content:**

**UNIT-I: Additive Manufacturing:** Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications.

**Additive Manufacturing Techniques:** Stereo-Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. CAD Data formats, Data translation, Data loss, .STL format. Process parameter, Process Selection for various applications.

**UNIT-II: Additive Manufacturing Application Domains:** Aerospace, Electronics, HealthCare, Defense, Automotive, Construction, Food Processing, Machine Tools

**Materials:** Polymers, Metals, Non-Metals, Ceramics Process, Process parameter, Process Selection for various applications. Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.

**UNIT-III: Additive Manufacturing Equipment:** Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting,

**Additive Manufacturing Process:** CAD Data Exchange. Generation of .stl files. Additive Manufacturing and its process plan.

**UNIT-IV: Post Processing: Requirement and Techniques:** Post processing of additively manufactured product. Support Removal, Sanding, Acetone treatment, polishing.

**Product Quality:** Inspection and defect analysis of the additively manufactured product. Defects and their causes.

**Reference Books:**

1. Ian Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
3. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.

Course Code	:	
Course Title	:	MECHATRONICS
Number of Credits	:	3
Prerequisites (Course code)	:	Nil
Course Category	:	OE

**Course Objectives:**

- Understand the basics of mechatronics and the elements used
- Understand the different types of power transmission elements and drives
- Know about the various types of hydraulic and pneumatic systems

**Course Outcomes:**

CO1: Understand the basics of Mechatronics and its importance

CO2: Understand the various types of sensors and processing devices used in mechatronics

CO3: Understand the working of belt, chain, gear, stepper motors and servo drives

**Course Content:**

**Unit-I: Introduction**

Introduction to Mechatronics, importance, example of Mechatronic systems Concept, Analysis and Design Process, Systems with mixed disciplines.

Mechanical Systems, Characteristics, Types of motions, Kinematic Links and Kinematic chains, Basics of Four bar mechanism.

Electronics Fundamentals Review: Resistor, capacitor, inductor, transistor.

**Unit-II: Elements in Mechatronics**

Sensors and transducers: Definition and classification of transducers, Schematic diagram, working principle and applications of Proximity Sensor and Hall Effect sensor; Definition of micro- sensors. Signal processing devices: Circuit, working principle and applications of Electronic filters (LPF,HPF,BPF,BRF) and Operational Amplifier; Data conversion devices: Overview of ADCs and DACs; Circuit, working and applications of 3-bitFlashADC and Binary-weighted DAC. Microprocessors: Generic architecture, features and applications.

PID Controllers: Block diagram, operation and applications.

**Unit-III: Power transmission elements and Drives**

Characteristics and applications of Belt and chain drives; Gears: Types, Gear trains: Simple and compound gear train, Velocity ratio, applications; Cams and their applications.

Stepper Motors, Servo Drives, Solenoids.

**Unit-IV: Hydraulic and Pneumatic Systems**

Flow, Pressure and Direction Control Valves, Actuators, Supporting Elements, Hydraulic Power Packs, Pumps, Production, Distribution and conditioning of compressed air, System Components and symbolic representations. Applications of Electro-hydraulic and Hydro-pneumatic systems.

**Reference Books:**

1. Mechatronics – Bolton. W, Pearson Education, 2014
2. Mechatronics, HMT Ltd, Tata McGraw Hill, New Delhi, 1998,
3. Analysis and design of Dynamic Systems Cochin ,Eraand Cadwallender AddisonWesley,
4. Mechatronics Engineering -Tomkinson, D.AndHorne, J.Longman, McGraw Hill,1996

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Course Code	:	
Course Title	:	Project Management
Number of Credits	:	3
Prerequisites (Course code)	:	Nil
Course Category	:	OE

**Course Objectives:**

The aim of this course is to:

- Develop the idea of project plan, identifying tasks and how goals will be achieved
- Develop an understanding of key project management skills and strategies

**Course Outcomes:**

By the end of this course, the students are expected to learn CO1: Understand the importance of projects and its phases.

CO2: Analyze the projects from various perspectives and evaluate them on discount method.

CO3: Develop network diagrams for planning and execution of a given project.

CO4: Apply crashing procedures for time and cost optimization

**Course contents:**

**Unit-I: Concept of a Project and Capital Budgeting**

Classification of projects, Importance of project management, Project life cycle, Establishing project priorities (scope-cost-time) Planning, Analysis, Selection, Financing, Implementation, Generation and screening of project ideas, Market and Demand analysis, Demand forecasting techniques.

**Unit-II: Financial Estimates and Projections**

Cost of projects, means of financing, estimates of sales and production, cost of production, working capital requirement and its financing, Break even analysis

**Unit-III: Basic Techniques in Capital Budgeting**

Non discounting and discounting methods, Payback period, Accounting rate of return, Net present value, Benefit cost ratio, Internal rate of return, Project risk, Social cost benefit analysis and economic rate of return.

**Unit-IV: Project Administration**

Expenditure planning, Project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off.

Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms, Post project evaluation, Introduction to various Project management softwares.

**References:**

1. Project planning, analysis, selection, implementation and review – Prasannachandra – TataMcGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson – McGraw Hill
3. Project management - David I Cleland - Mcgraw Hill International Edition, 1999
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Pearson Publication.

Course Code	:	
Course Title	:	Energy Conservation and Audit
Number of Credits	:	3 (L: 3, T: 0 P: 0)
Prerequisites	:	Computer Aided Design & Drafting
Course Category	:	OE

**Course Objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- To Identify demand supply gaps in present scenario.
- To understand conservations approaches to an industry.
- To draw the energy flow diagram of an industry.

**Course Outcomes:**

At the end of the course students will be able to:

CO1: Identify demand supply gaps in the present scenario. CO2: Understand the conservation approaches for an industry.

CO3: Draw the energy flow diagram of and industry and identify waste stream. CO4: Identify energy wastage and evaluate the concepts of energy audit.

**Course Contents:**

**Unit-I: Introduction**

General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits, Energy Efficiency Principle of Maximum energy efficiency, Maximum cost effectiveness, Mandatory provisions and features of EC act Standards, Energy Conservation Building Codes (ECBC)

**Unit-II: Energy Conservation Approaches and Option**

Methods and techniques of energy conservation in ventilation and air conditioners- compressors pumps and blowers, Insulating the Heating / cooling fluid pipes, automatic door closing, Thermostat/ Control, Energy conservation in electric furnaces and boilers.

New equipment and technology for Energy Conservation Option, staffing, training, Calculation and costing of energy conservation project, Depreciation Cost, Cost evaluation by Return On Investment (ROI) and pay back method.

**Unit-III: Performance improvement of existing power plant**

Cogeneration, small hydro, DG Set, Demand side management, Load response programmes, Types of tariffs and restructuring of electric tariff technical measures to optimize T and D losses.

**Unit-IV: Energy Audit**

Energy audit and its benefits, Energy flow diagram, preliminary and detailed energy audit, Methodology of preliminary energy audit and detailed energy audit – Phase I (Pre audit), Phase II (Audit) and Phase III (Post audit), Energy audit report, Power Analyzer

**References:**

1. Electric Energy Generation, Utilisation and Conservation Sivaganaraju, S Pearson, New Delhi, 2012
2. Project Management, Prasanna Chandra, Tata Mcgraw Hill, New Delhi
3. Financial Management, Prasanna Chandra Tata Mcgraw Hill, New Delhi.
4. Energy management Handbook, Prasanna Chandra, Tata Mcgraw Hill, New Delhi.

Course Code	:	
Course Title	:	Renewable Energy Technologies
Number of Credits	:	3 (L: 3, T: 0 P: 0)
Prerequisites	:	Nil
Course Category	:	OE

**Course Objectives:**

- To understand present and future scenario of world energy use.
- To understand fundamentals of solar energy systems.
- To understand basics of wind energy.
- To understand bio energy and its usage in different ways.
- To identify different available non-conventional energy sources.

**Course outcomes:**

After Completing this Course, Students will be able to

- Understand the importance of renewable energy.
- Understand the methods of harnessing the solar energy.
- Understand the methods of harnessing the solar energy.
- Understand the biomass energy conversion and other hybrid systems.

**Course Content:**

**UNIT-I: Introduction:** World Energy Use, Environmental Aspects of Energy Utilisation, Renewable Energy Scenario in India and around the World, Potentials and Economics of renewable energy systems.

**Unit-II: Solar energy:** Solar Radiation, Measurements of Solar Radiation, Flat Plate and Concentrating Collectors, Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power applications.

**Unit-III: Wind Energy:**

Wind Data and Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator. Safety and environmental aspects.

**Unit-IV: Bio Energy and Other Renewable Energy Sources:**

Biomass direct combustion, Biomass gasifiers, Biogas plants, Bio diesel, Biomass applications Tidal energy; Wave Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

**References :**

1. Energy Technology, O.P. Gupta, , Khanna Publishing House, Delhi (ed. 2018)
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006.
3. Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B Natarajan, P Monga, Tata McGraw Hill.

Course Code	:	
Course Title	:	ROBOTICS
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	OE

**Course Objectives:**

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.

**Course outcomes:**

At the end of the course, the student will be able to:

CO1: Explain the robot anatomy, classification, characteristics of robot, advantages and Disadvantages.

CO2: Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.CO3: Explain about various types of sensors and concepts on robot vision system.

CO4: Explain the concepts of robot programming languages and various applications of robots.

**Course Content:**

**UNIT-I:** Fundamentals of Robotics: Brief history, Definition of Robot; Robot anatomy and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Degrees of freedom, work envelope and work volume, Classification of robots; Cartesian, Cylindrical, Spherical, SCARA; Characteristics of robots; Effect of structure on control work envelope and work volume; comparison; Advantages and disadvantages of robots.

**Unit-II:** Robotic Drive System and Controller: Actuators; Characteristics of Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Levels of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control.

**Unit-III:** Sensors: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo-electric); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing.

Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Vidicon camera (Working principle & construction); Applications of Robot vision system: Inspection and Identification.

**Unit-IV:** Robot kinematics and Robot Programming: Definition of Forward Kinematics; Inverse Kinematics; Forward and Inverse Kinematics of R-R planar manipulator.

Definition of Path and Trajectory Planning; Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effector commands.

Industrial Applications: Application of robots in material handling; welding; painting and assembly operations.

**Reference Books:**

1. Introduction to Robotics: Analysis, Systems, Applications - Saeed B. Niku, Pearson Education Inc. New Delhi 2006.
2. Industrial Robotics: Technology, Programming and Applications - M.P. Groover, Tata McGraw Hill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence - Fu.K.S. Gonzalz.R.C and Lee C.S.G, McGraw Hill Book Co, 1987.
4. Robotics for Engineers - Yoram Koren, McGraw Hill Book Co, 1992.
5. A Text book on Industrial Robotics - Ganesh S. Hedge, Laxmi Publications Pvt. Ltd., New Delhi, 2008.
6. Robotics Technology and Flexible Automation - S.R. Deb & Sankha Deb, Tata McGraw-Hill, 2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018.

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Course Title: **Indian Constitution**

Course Code:

<b>Scheme of Instruction</b>	<b>Scheme of Examination</b>
Total Duration: 30 Hours Periods / Week: 2 Credits: 0 Instruction Mode: Lecture	Maximum Marks: 50 Internal Evaluation: 20 External Evaluation: 30 Exam Duration: 3 Hours

Course Content

***Unit 1 – The Constitution - Introduction***

- The History of the Making of the Indian Constitution
- Preamble and the Basic Structure, and its interpretation
- Fundamental Rights and Duties and their interpretation
- State Policy Principles

**Unit 2 – Union Government**

- Structure of the Indian Union
- President – Role and Power
- Prime Minister and Council of Ministers
- Lok Sabha and Rajya Sabha

**Unit 3 – State Government**

- Governor – Role and Power
- Chief Minister and Council of Ministers
- State Secretariat

**Unit 4 – Local Administration**

- District Administration
- Municipal Corporation
- Zila Panchayat

**Unit 5 – Election Commission**

- Role and Functioning
- Chief Election Commissioner, State Election Commission

Suggested Learning Resources:

<b>S. No.</b>	<b>Title of Book</b>	<b>Author</b>	<b>Publication</b>
1.	Ethics and Politics of the Indian Constitution	Rajeev Bhargava	Oxford University Press, New Delhi, 2008
2.	The Constitution of India	B.L. Fadia	Sahitya Bhawan; New edition (2017)
3.	Introduction to the Constitution of India	DD Basu	Lexis Nexis; Twenty-Third 2018 edition

**Suggested Software/Learning Websites:**

<https://www.constitution.org/cons/india/const.html>

<http://www.legislative.gov.in/constitution-of-india>

<https://www.sci.gov.in/constitution>

<https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

## MINOR PROJECT

### Course Objectives:

1. To enable students learn by doing.
2. To develop capability to analyse and solve real world problems
3. To develop innovative ideas among the students

### Course Outcomes: Students should be able to do the following:

1. To provide innovative solutions
2. To work in a team
3. To manage time and resources in the best possible manner

Students are required to choose a topic for minor project related to the courses of this semester. Student has to implement and present the project as per the given schedule. During the implementation of the project, student has to follow the schedule given below. Report of the project work has to be submitted for evaluation.

### Schedule:

S.No	Description	Duration
1.	Problem Identification / Selection	4 weeks
2.	Preparation of Abstract	1 week
3.	Design, Implementation & Testing of the Project	5 weeks
4.	Documentation & Project Presentation	2 weeks

### Guidelines for the Award of marks:

S.No.	Description	CIE Max. Marks 60	SEE Max. Marks 40
1.	Weekly Assessment	20	--
2.	Design/ Implementation	20	10
3.	Presentation	10	10
4.	Viva Voce	10	10
5.	Report	-	10

Final Minor Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Minor project for that class.

## MAJOR PROJECT

### Course Objectives:

1. To impart team building and management skills among students.
2. To instill writing and presentation skills for completing the project.
3. Plan, Analyse, Design and implement a project.

### Course Outcomes: Students should be able to do the following:

1. Find the solution of identified problem with the help of modern Technology and give priority to realtime scenarios.
2. Plan to work as a team and to focus on getting a working project done and submit a report within astipulated period of time.
3. Prepare and submit the Report and deliver presentation before the departmental Committee.

Students are required to choose a topic for major project related to the courses of this semester. Student has to implement and present the project as per the given schedule. During the implementation of the project, student has to follow the schedule given below. Report of the project work has to be submitted for evaluation.

### Schedule:

S.No	Description	Duration
1.	Problem Identification / Selection	5 weeks
2.	Preparation of Abstract	2 week
3.	Design, Implementation & Testing of the Project	12 weeks
4.	Documentation & Project Presentation	5 weeks

### Guidelines for the Award of marks:

S.No	Description	CIE Max. Marks 120	SEE Max. Marks 80
1.	Weekly Assessment	30	--
2.	Design/ Implementation	50	20
3.	Presentation	20	20
4.	Viva Voce	20	20
5.	Report	-	20

Final Major Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Major Project for that class.