

CURRICULUM

First Year (1st and 2nd Semester)

THREE YEAR DIPLOMA PROGRAMME IN

Group- A (Computer Engineering, Information Technology, Electrical Engineering, Agriculture Engineering, Electronics and Communication Engineering, Computer Engineering & Internet of Things(IoT), Electrical Engineering & Electrical Vehicle Technology)

Group-B (Civil Engineering, Mechanical Engineering, Automobile Engineering, Instrumentation Engineering, Electrical & Electronics Engineering, Mechanical Engineering (Tool & Die), Mechanical Engineering (Refrigeration and Air Conditioning), Mechatronics)

(N-2022 SCHEME)

FOR THE STATE OF HIMACHAL PRADESH



Session 2022-23

Prepared by: -

Composite Curriculum Development Centre

Directorate of Technical Education,

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SALIENT FEATURES

Programme	<p>Three Year Diploma</p> <p>Group-A (Computer Engineering, Information Technology, Electrical Engineering, Agriculture Engineering, Electronics and Communication Engineering, Computer Engineering & Internet of Things(IoT), Electrical Engineering & Electrical Vehicle Technology)</p> <p>Group-B (Civil Engineering, Mechanical Engineering, Automobile Engineering, Instrumentation Engineering, Electrical & Electronics Engineering, Mechanical Engineering (Tool & Die), Mechanical Engineering (Refrigeration and Air Conditioning), Mechatronics)</p>
Duration	Three years (Six Semesters)
Entry Qualification	As prescribed by H.P. Takniki Shiksha Board /AICTE
Intake	As approved by H.P. Takniki Shiksha Board
Pattern	Semester System
Curriculum for	<p>First Year Common For Branches: Computer Engineering, Information Technology, Electrical Engineering, Agriculture Engineering, Electronics and Communication Engineering, Civil Engineering, Mechanical Engineering, Automobile Engineering, Instrumentation Engineering, Electrical & Electronics Engineering, Computer Engineering & Internet of Things(IoT), Electrical Engineering & Electrical Vehicle Technology, Mechanical Engineering (Tool & Die), Mechanical Engineering (Refrigeration and Air Conditioning), Mechatronics.</p>

Course code and definition:

Course code	Definitions
L	Lecture
DCS	Doubt Clearing Session
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

GENERAL GUIDELINES FOR CURRICULUM IMPLEMENTATION

1. Weightage for the internal assessment in respect of theory subjects will be as follow:
 - a. House Test: 40%
 - b. Class Test: 20%
 - c. Home Assignment: 20%
 - d. Attendance: 20%
2. There will be two class tests in every semester and the average of the two tests will be taken into account.
3. The syllabus for the class tests will be as under:
 - a. Class Test-I: 30% of syllabus
 - b. Class Test-II: next 30% of syllabus
4. Class Test-I &II will be conducted as per Academic Calendar.
5. The 30%, 60% and 80% contents of the syllabus will be based on the number of hours allocated for the topics in the detailed curriculum of each subject.
6. The question paper for both the class tests will be of 30 marks each and of one- hour duration.
7. Improvement test can be conducted after every class test on the basis of some genuine reason to be judged by the Head of concerned Department.
8. There will be one house test as per Academic Calendar and syllabus coverage will be 80%.
9. The house test will be of total 60 marks and the duration of House Test should be two hours.
10. In case student fails to attend the house test due to genuine reasons, re-examination will be conducted with the approval of concerned Principal on the recommendation of concerned Head of Department.
11. There will be minimum two home assignments per subject per semester.
12. Weightage for the internal assessment in respect of Practical subject should be:
 - a. Practical Performance: 60%, Report Writing: 20% and Viva Voce: 20%
13. Weightage for Internal Assessment in respect of Drawing subjects will be asunder:
 - a. House Test and Class Test =40%

- a) Class performance/Drawings Sheets 40%
- b) Attendance/punctuality =10%
- c) Viva Voce =10%

14. For 13 a), b), c) marks should be given in each drawing sheet by concerned teacher during evaluation.

15. It is suggested that students may be taken for industrial visits for industrial exposure in second year and third year.

16. Student Centered Activities: A provision has been made for organizing Student Centered Activities for overall personality development of students. SCA will comprise co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, cultural activities and participation in programs like technical and cultural events etc.

Distribution of marks for SCA will be as follows:

- 20% marks shall be given for general behaviour.
- 20% marks for attendance.
- 60% Marks shall be given for the Sports/Cultural and Co-curricular activities /other activities after due consideration.

Note: These marks are to be sent to the H.P. Takniki Shiksha Board, Dharmashala at the end of semester along with internal assessment.

17. **INDUCTION PROGRAM:** -The students will have to undergo a mandatory induction program for one week as per Academic Calendar as per the suggestive list of activities mentioned in the AICTE Model Curriculum 2019.

STUDY AND EVALUATION SCHEME

Semester- I (Group- A)

Sr. No.	Category of Course	Code No.	Course Title	Hours/Week			Total Hrs/week	Credits	Evaluation Scheme						
				L	P	DCS			Internal		External			Total	
							Th	Pr	Th	Hrs.	Pr	Hrs.			
1.	Basic Science	BS101	Mathematics-I	3	0	2	5	3	40		60	3			100
2.	Basic Science	BS103	Applied Physics-I	3	0	1	4	3	40		60	3			100
3.	Basic Science	BS105	Applied Chemistry	3	0	1	4	3	40		60	3			100
4.	Humanities & Social Science	HS101	Communication Skills in English	2	0	1	3	2	40		60	3			100
5.	Engineering Science	ES101	Engineering Graphics	0	3	1	4	1.5		40	60	3			100
6.	Engineering Science	ES103	Engineering Workshop Practice	0	3	3	6	1.5		40			60	3	100
7.	Basic Science	BS107	Applied Physics-I Lab	0	2	0	2	1		40			60	3	100
8.	Basic Science	BS109	Applied Chemistry Lab	0	2	0	2	1		40			60	3	100
9.	Humanities & Social Science	HS103	Sports and Yoga	0	2	0	2	1		40			60	3	100
10.	Humanities & Social Science	HS105	Communication Skills in English Lab	0	2	0	2	1		40			60	3	100
11.			SCA	0	2	0	2	0		25			0		25
Total Teaching Load				11	16	9	36								
Total								18	160	265	300		300		1025

STUDY AND EVALUATION SCHEME

Semester- I (Group-B)

Sr. No.	Category of Course	Code No.	Course Title	Hours/Week			Total Hrs/week	Credits	Evaluation Scheme						
				L	P	DCS			Internal		External			Total	
									Th	Pr	Th	Hrs.	Pr		Hrs.
1.	Basic Science	BS101	Mathematics-I	3	0	2	5	3	40		60	3			100
2.	Basic Science	BS103	Applied Physics-I	3	0	1	4	3	40		60	3			100
3.	Basic Science	BS105	Applied Chemistry	3	0	1	4	3	40		60	3			100
4.	Humanities & Social Science	HS101	Communication Skills in English	2	0	1	3	2	40		60	3			100
5.	Engineering Science	ES102	Introduction to IT Systems	2	0	0	2	2	40		60	3			100
6.	Engineering Science	ES101	Engineering Graphics	0	3	1	4	1.5		40	60	3			100
7.	Engineering Science	ES108	Introduction to IT Systems Lab	0	4	0	4	2		40			60	3	100
8.	Basic Science	BS107	Applied Physics-I Lab	0	2	0	2	1		40			60	3	100
9.	Basic Science	BS109	Applied Chemistry Lab	0	2	0	2	1		40			60	3	100
10.	Humanities & Social Science	HS103	Sports and Yoga	0	2	0	2	1		40			60	3	100
11.	Humanities & Social Science	HS105	Communication Skills in English Lab	0	2	0	2	1		40			60	3	100
			SCA	0	2	0	2	0		25			0		25
Total Teaching Load				13	17	6	36								
Total								20.5	200	265	360		300		1125

STUDY AND EVALUATION SCHEME

Semester- II (Group- A)

Sr. No.	Category of Course	Code No.	Course Title	Hours/Week			Total Hrs/week	Credits	Evaluation Scheme						
				L	P	DCS			Internal		External			Total	
							Th	Pr	Th	Hrs.	Pr	Hrs.			
1.	Basic Science	BS102	Mathematics-II	4	0	1	5	4	40		60	3			100
2.	Basic Science	BS104	Applied Physics-II	3	0	1	4	3	40		60	3			100
3.	Engineering Science	ES102	Introduction to IT Systems	2	0	0	2	2	40		60	3			100
4.	Engineering Science	ES104	Fundamentals of Electrical & Electronics Engineering	3	0	1	4	3	40		60	3			100
5.	Engineering Science	ES106	Engineering Mechanics	3	0	1	4	3	40		60	3			100
6.	Basic Science	BS106	Applied Physics-II Lab	0	2	0	2	1		40			60	3	100
7.	Engineering Science	ES108	Introduction to IT Systems Lab	0	4	0	4	2		40			60	3	100
8.	Engineering Science	ES110	Fundamentals of Electrical & Electronics Engineering Lab	0	2	0	2	1		40			60	3	100
9.	Engineering Science	ES112	Engineering Mechanics Lab	0	2	0	2	1		40			60	3	100
10.	Audit	AU102	Environmental Science	2	0	0	2	0	40		60	3			100
11.			SCA	0	2	0	2	0		25			0		25
Total Teaching Load				17	12	4	33								
Total								20	240	185	360		240		1025

STUDY AND EVALUATION SCHEME

Semester- II (Group- B)

Sr. No.	Category of Course	Code No.	Course Title	Hours/Week			Total Hrs/ week	Credits	Evaluation Scheme						
				L	P	DCS			Internal		External			Total	
									Th	Pr	Th	Hrs.	Pr		Hrs.
1.	Basic Science	BS102	Mathematics-II	4	0	1	5	4	40		60	3			100
2.	Basic Science	BS104	Applied Physics-II	3	0	1	4	3	40		60	3			100
3.	Engineering Science	ES104	Fundamentals of Electrical & Electronics Engineering	3	0	1	4	3	40		60	3			100
4.	Engineering Science	ES106	Engineering Mechanics	3	0	1	4	3	40		60	3			100
5.	Basic Science	BS106	Applied Physics-II Lab	0	2	0	2	1		40			60	3	100
6.	Engineering Science	ES103	Engineering Workshop Practice	0	3	3	6	1.5		40			60	3	100
7.	Engineering Science	ES110	Fundamentals of Electrical & Electronics Engineering Lab	0	2	0	2	1		40			60	3	100
8.	Engineering Science	ES112	Engineering Mechanics Lab	0	2	0	2	1		40			60	3	100
9.	Audit	AU102	Environmental Science	2	0	0	2	0	40		60	3			100
10.			SCA	0	2	0	2	0		25			0		25
Total Teaching Load				15	11	7	33								
Total								17.5	200	185	300		240		925

DETAILED CONTENTS OF FIRST YEAR

Mathematics- I (BS101)

Course Code	:	BS101
Course Title	:	Mathematics- I
Number of Credits	:	3(L: 3, DCS: 2, P: 0)
Prerequisites	;	NIL
Course Category	:	BS

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 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 $\sin x$, $\cos x$.

UNIT-II Differential Calculus

Definition of function; Concept of limits. Four standard limits $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$, $\lim_{x \rightarrow 0} \frac{\sin x}{x}$, $\lim_{x \rightarrow 0} (1 + x)^{\frac{1}{x}}$ and $\lim_{x \rightarrow 0} \frac{a^x - 1}{x}$.

Differentiation by definition of x^n , $\sin x$, $\cos x$, $\tan x$ and e^x . Differentiation of sum, product and quotient of functions. Differentiation of function of a function. Differentiation of trigonometric and inverse trigonometric functions, Logarithmic differentiation.

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-movier's theorem, its application.

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.

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.

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayanan, Engineering Mathematics, 6/e., Vikas Publishing House.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi.

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 into 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.

Distribution of Time and Marks

Unit	Time (Hours)	Marks %age
1	22	30
2	22	30
3	36	40
Total	80	100

APPLIED PHYSICS –I (BS103)

Course Code	:	BS103
Course Title	:	Applied Physics-I
Number of Credits	:	3(L: 3;DCS: 1, P: 0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

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.

Teaching Approach:

- Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.
- Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.
- Activity- Theory - Demonstrate/practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content:

Unit 1: Physical world, Units and Measurements

Physical quantities: fundamental and derived, Units and systems of units (FPS, CGS and SI units), Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis. Errors in measurements (systematic and random), absolute error, relative error, error estimation and significant figures.

Unit 2: Force and Motion

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 (Rectangular components) and lawn roller.

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, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

Unit 3: Work, Power and Energy

Work: Concept and units, examples of zero work, positive work and negative work
Friction: concept, types, laws of limiting friction, coefficient of friction, methods for reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications.

Energy and its units, kinetic energy, gravitational potential energy with examples and derivations,

Mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples).

Power and its units, power and work relationship, calculation of power (numerical problems).

Unit 4: Rotational Motion

Translational and rotational motions with examples.

Definition of torque and angular momentum and their examples.

Conservation of angular momentum (quantitative) and its applications.

Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid): (Formulae only).

Unit 5: Properties of Matter

Elasticity: Definition of stress and strain, different types of moduli of elasticity, Hooke's law, significance of stress-strain curve.

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, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.

Unit 6: Heat and Thermometry

Concept of heat and temperature.

Modes of heat transfer (conduction, convection and radiation with examples), 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, Co-efficient of thermal conductivity.

Course Outcomes:

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.
- Analyze 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.
- State the principle of conservation of energy. Identify various forms of energy, and energy transformations.
- Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
- Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces.
- Define stress and strain. State Hooke's law and elastic limits, stress-strain diagram, determine; (a) the modulus of elasticity, (b) the yield strength (c) the tensile strength, and (d) estimate the percent elongation.
- Illustrate the terms; heat and temperature, measure temperature in various processes on different scales (Celsius, Fahrenheit, and Kelvin etc.).

- Distinguish between conduction, convection and radiation; identify different methods for reducing heat losses and mode of heat transfer between bodies at different temperatures.

References:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
5. Engineering Physics by DK Bhattacharya & PoonamTandan; Oxford University Press, New Delhi.
6. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
7. Practical Physics by C. L. Arora, S. Chand Publication.
8. e-books/e-tools/ learning physics software/websites etc.

SUGGESTED DISTRIBUTION OF MARKS

UNIT/TOPIC	TIME ALLOTTED	MARKS ALLOTTED (%)
1	10	15
2	12	20
3	10	15
4	10	15
5	12	20
6	10	15
TOTAL	64	100

APPLIED CHEMISTRY (BS105)

Course Code	:	BS105
Course Title	:	Applied Chemistry
Number of Credits	:	3 (L: 3,DCS:1, P: 0)
Prerequisites	:	High School Level Chemistry
Course Category	:	BS

Course Objectives:

There are numerous number 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. On successful completion of this course content will enable technicians to understand, ascertain and analyse and properties of natural raw materials require for producing economical and eco-friendly 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.

Course Content:

1. Atomic Structure

1.1 Fundamental particles of atoms : Electron, proton, neutron (Definitions) **1.2** Atomic Structure: Bohr's theory, successes and limitations(expression of energy and radius to be omitted), and Hydrogen spectrum explanation based on Bohr's model of atom, **1.3** Heisenberg uncertainty principle, Quantum numbers – orbital concept, Shapes of s, p orbitals, difference between orbit and orbital **1.4** Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration(Z=1 to 30).

2. Chemical bonding and Solutions

2.1 Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example) **2.2** Lewis concept of covalent bond (H₂, F₂, HF). Electronegativity, Difference between sigma and pi bond **2.3** Electron sea model of metallic bond. **2.4** Idea of solute, solvent and solution

2.5 Methods to express the concentration of solution- molarity (M = mole per liter), molality, mass percentage (Numerical excluded).

3. Electro Chemistry and Corrosion

3.1 Electronic concept of oxidation, reduction and redox reactions. Definition of terms: electrolytes, non-electrolytes with suitable examples, **3.2** Faradays laws of electrolysis and simple numerical problems. **3.3** Industrial application of Electrolysis – • Electrometallurgy • Electroplating • Electrolytic refining. **3.4** Application of redox reactions in electrochemical cells – • Primary cells – dry cell, • Secondary cell - commercially used lead acid storage battery.

3.5 Introduction to Corrosion of metals – definition, types of corrosion (electrochemical), H₂ liberation and O₂ absorption mechanism of electrochemical corrosion, **3.6** Internal corrosion preventive measures – Purification, alloying and heat treatment and External corrosion preventive measures: metal (anodic, cathodic) coatings.

4. Engineering Materials

4.1 Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (matrix), flux, slag, metallurgy – brief account of general principles of metallurgy (a) Crushing and grinding (b) Concentration of ore (Levigation, Froth flotation, Magnetic separation) (c) Extraction (Roasting and calcinations & smelting) (d) Refining (Electro refining, zone refining). **4.2** Extraction of - iron from haematite ore using blast furnace along with reactions. **4.3** Alloys – definition, purposes of alloying, ferrous alloys (Invar steel) and non-ferrous (Simple Brass & Bronze, Nichrome, Duralumin, Magnesium) with suitable examples, properties and applications.

5. Water

5.1 Classification of soft and hard water based on soap test, salts causing water hardness, units of hardness (mg/L and ppm) and simple numerical on water hardness. Cause of poor lathering of soap in hard water,

5.2 Problems caused by the use of hard water in boiler (scale and sludge, foaming and priming, corrosion.) **5.3** i) water softening techniques- zeolite process ii). Municipal water treatment (in brief only) – sedimentation, coagulation, filtration, sterilization. **5.4** Properties of water used for human consumption for drinking and cooking purposes from any water sources and Indian standard specification of drinking water.

6. Fuels

6.1 Definition of fuel and combustion of fuel, classification of fuels **6.2** calorific values (HCV and LCV), calculation of HCV and LCV using Dulong's formula. Characteristics of good fuel **6.3** Petrol and diesel - fuel rating (octane and cetane numbers) **6.4** Chemical composition, calorific values and applications of LPG, CNG, water gas, producer gas and biogas.

7. Lubrication

7.1 Function and characteristic properties of good lubricant, **7.2** classification with examples **7.3** Lubrication mechanism – hydrodynamic and boundary lubrication **7.4** 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.

8. Polymers

8.1 Monomer, homo and co polymers , degree of polymerization 8.2 simple reactions involved in preparation and their application of thermoplastics and thermosetting plastics (using Polythene, PVC, PS, PTFE, nylon-6,6 and Bakelite only) 8.3 Vulcanization of rubber and properties of vulcanised rubber.

References/Suggested Learning Resources:

(a) 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.
- 3) C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
- 4) Dara, S. S. & Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Delhi, 2015.
- 5) Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
- 6) Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
- 7) Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
- 8) Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

(b) Open source software and website address:

- 1 www.chemguide.co.uk/atommenu.html (Atomic structure and chemical bonding)
- 2 www.visionlearning.com (Atomic structure and chemical bonding)
- 3 www.chem1.com (Atomic structure and chemical bonding)
- 4 <https://www.wastewaterelearning.com/elearning/> (Water Treatment)
- 5 www.capital-refractories.com (Metals, Alloys, Cement, and Refractory Materials)
- 6 www.em-ea.org/guide%20books/book-2/2.1%20fuels%20and%20combustion.pdf (Fuel and Combustion)

Course 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, and refractory using knowledge of chemical bonding.
2. Understand and assess the suitability of water source for domestic and industrial application, effluents and minimise 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.
b) Understand corrosion and develop economical prevention techniques.

SUGGESTED DISTRIBUTION OF HOURS & MARKS

Units	Time Allotted(Hrs)	Marks Allotted(%)
1.	8	12
2.	8	12
3.	11	17
4.	8	14
5.	9	12
6.	8	12
7.	8	12
8.	4	9
Total	64	100

Communication Skills in English (HS101)

Course Code	:	HS101
Course Title	:	Communication Skills in English
Number of Credits	:	2(L: 2,DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	HS

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 are:

1. To develop confidence in speaking English with correct pronunciation.
2. To develop communication skills of the students i.e. listening, speaking, reading and writing skills.
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.

Unit-1 Communication: Theory and Practice

1. Basics of communication: Introduction, meaning and definition, process of communication etc.
2. Types of communication: formal and informal, verbal, non-verbal and written
Barriers to effective communication.
3. 7Cs for effective communication (considerate, concrete, concise, clear, complete, correct, courteous).
4. Art of Effective communication,
 - A. Choosing words
 - B. Voice
 - C. Modulation
 - D. Clarity
 - E. Time
 - F. Simplification of words
5. Technical Communication.

Unit-2 Soft Skills for Professional Excellence

1. Introduction: Soft Skills and Hard Skills.
2. Importance of soft skills.

3. Life skills: Self-awareness and Self-analysis, adaptability, resilience, emotional intelligence and empathy etc.
4. Applying soft skills across cultures.

Unit-3: Reading Comprehension

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

Section-1 Short Stories

1. “The Gift of the Magi” by O. Henry.
2. “Uncle Podger Hangs a Picture” Jerome K. Jerome.

Section-2 Poetry

1. “Night of the Scorpion” by Nissim Ezekiel.
2. “Stopping by Woods on a Snowy Evening” by Robert Frost.
3. “Where the Mind is Without Fear” by Rabindranath Tagore.

Unit-4 Professional Writing

1. The art of précis writing.
2. Letters: business and personal.
3. Drafting e-mail, notices, minutes of a meeting etc.

Unit-5 Vocabulary and Grammar

1. Glossary of administrative terms (English and Hindi).
2. One-word substitution, Idioms and phrases etc.
3. Parts of speech, active and passive voice, tenses etc., Punctuation.

References:

1. J.D.O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 1980.
2. Lindley Murray. *An English Grammar: Comprehending Principles and Rules*. London: Wilson and Sons, 1908.
3. Kulbhushan Kumar, *Effective Communication Skills*, Khanna Publishing House, New Delhi (Revised Edition 2018)
4. Margaret M. Maison. *Examine your English*. Orient Longman: New Delhi, 1964.
5. M. Ashraf Rizvi. *Effective Technical Communication*. Mc-Graw Hill: Delhi, 2002.
6. John Nielson. *Effective Communication Skills*. Xlibris, 2008.
7. Oxford Dictionary

8. Roget's Thesaurus of English Words and Phrases
9. Collin's English Dictionary

Course Outcomes:

At the end of this course, the participants will:

1. 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.
2. Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
3. Also develop skills of group presentation and communication in team.
4. Develop non-verbal communication such as proper use of body language and gestures.

SUGGESTED DISTRIBUTION OF HOURS & MARKS

Topic No.	Time Allotted(Hrs)	Marks Allotted
1	11	20
2	7	10
3	13	30
4	8	20
5	9	20
Total	48	100

Engineering Graphics

Course Code	:	ES101
Course Title	:	Engineering Graphics
Number of Credits	:	1.5 (L: 0,DCS:1, P: 3)
Prerequisites	:	NIL
Course Category	:	ES

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, of how to draw, modify, and edit basic shapes (2D), using AUTOCAD.

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.

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)

Unit – III 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 – IV Free Hand Sketches of engineering elements

Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, wash-er, 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 – V 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, sta- tus 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.

Unit – VI 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.

Dim scale variable. Editing dimensions. Text: Single line Text, Multiline text.

Sr. No.	Practical Exercises	ED Sheets	Approx. Hrs
1	Draw horizontal, Vertical, 30 degrees, 45 degrees, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/drafter.	1	05
2	Write alphabets and numerical in 7:4 scale (Vertical only) (do this exercise in sketch book).		
3	Draw some problems on Engineering Plain and	2	06

	diagonal scale.		
4	Draw some problems on orthographic projections using first angle method of projection having plain and slanting, cylindrical surfaces, ribs and slots.	3	08
5	Draw some problems on Isometric view of simple objects having plain and slanting and cylindrical surface (e.g. Cube, Cone and cylinder etc.) by using natural scale.	2	08
6	Draw free hand sketches/ conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements.	2	06
7	Problem based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book.	1	05
8	Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD (Print out should be a part of progressive assessment).	1	03
9	Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD (Printout should be a part of progressive assessment).		03
10	Draw basic 2D entities like: Circular and rectangular array using AutoCAD (Printout should be a part of progressive assessment).	1	03
11	Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment).		05
12	Draw basic branch specific components in 2D using AutoCAD (Print out should be a part of term work).	2	06
13	Draw complex branch specific components in 2D using AutoCAD (Print should be a part of progressive assessment).	2	06
	Total	Instrumental :11 +CAD:6 = 17	64

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

Note: 1. Minimum 14 sheets to be prepared with at-least 4 sheets in Auto CAD.

2. AutoCAD sheets will be considered for internal evaluation only.

SUGGESTED LEARNING RESOURCES

1. Bureau of Indian Standards. Engineering Drawing Practice for Schools and Colleges IS: Sp-46. BIS. Government of India, Third Reprint, October 1998; ISBN: 81-7061-091-2.
2. Bhatt, N. D. *Engineering Drawing*. Charotar Publishing House, Anand, Gujrat 2010; ISBN: 978- 93- 80358-17-8.
3. Jain & Gautam, *Engineering Graphics & Design*, Khanna Publishing House, New Delhi (ISBN: 978- 93-86173-478).
4. Jolhe, D. A. *Engineering Drawing*. Tata McGraw Hill Edu. New Delhi, 2010; ISBN: 978-0-07- 064837-1.
5. Dhawan, R. K. *Engineering Drawing*. S. Chand and Company, New Delhi; ISBN:81-219-1431-0.
6. Shah, P. J. *Engineering Drawing*. S. Chand and Company, New Delhi, 2008, ISBN:81-219-2964-4.
7. Kulkarni, D. M.; Rastogi, A. P.; Sarkar, A. K. *Engineering Graphics with AutoCAD*. PHI Learning Private Limited-New Delhi (2010); ISBN: 978-8120337831.
8. Jeyapoovan, T. *Essentials of Engineering Drawing and Graphics using AutoCAD*. Vikas Publishing House Pvt. Ltd, Noida, 2011; ISBN: 978-8125953005.
9. Autodesk. *AutoCAD User Guide*. Autodesk Press, USA, 2015.
10. Sham, Tickoo. *AutoCAD 2016 for Engineers and Designers*. Dreamtech Press; Galgotia Publication, New Delhi, 2015; ISBN 978-9351199113.

Software/Learning Websites

1. <https://www.youtube.com/watch?v=TJ4jGyD-WCw>
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MQScnLXL0M
4. <https://www.youtube.com/watch?v=3WXPanCq9LI>
5. <https://www.youtube.com/watch?v=fvjk7PlxAuo>
6. <http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf>
7. <https://www.machinedesignonline.com>

Course Outcomes:

Following outcomes will be achieved:

- 1) Select and construct appropriate drawing scales, use drawing equipment's, 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.

Engineering Workshop Practice

Course Code	:	ES103
Course Title	:	Engineering Workshop Practice
Number of Credits	:	1.5 (L: 0,DCS:3, P: 3)
Prerequisites	:	NIL
Course Category	:	ES

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 house wiring.
- To understand, operate, control different machines and equipment's adopting safety practices.

Course Content:

Sr. No.	Details Of Practical Content
1.	Carpentry: i) Demonstration of different wood working tools / machines. ii) Demonstration of different wood working processes, like planing, marking, chiseling, grooving, turning of wood etc.iii) One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.
2.	Fitting: i) Demonstration of different fitting tools and drilling machines and power tools ii) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. iii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc.
3.	Welding: i) Demonstration of different welding tools / machines. 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.
4.	Sheet Metal Working: i) Demonstration of different sheet metal tools / machines. ii) Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting. iii) One simple job involving sheet metal operations and soldering and riveting.
5.	Smithy Shop*: i) Demonstration and explanation of tools & equipment used. Safety measure to be observed in smithy shop. ii) Demonstration of bending operation, up-setting operation. iii) Description and specifications of anvils, swage blocks, hammer etc. IV) Demonstration and description of tongs, fullers. V) To forge a L-hook.

6.	Electrical House Wiring: 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, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-in- stall bedroom lighting. (v) Simple lamp circuits- install stair case wiring. vi) Demonstration of measurement of Current, Voltage, Power and Energy.vii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. viii) Tools for Cutting and drilling.
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References:

1. S.K. Hajara Chaudhary, Workshop Technology, Media Promoters and Publishers, New Delhi, 2015
2. B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai and sons, New Delhi 2014
3. K. Venkat Reddy, Workshop Practice Manual, BS Publications, Hyderabad 2014
4. Kents Mechanical Engineering Hand book, John Wiley and Sons, New York

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.

SUGGESTED DISTRIBUTION OF HOURS & MARKS

Topic No.	Time Allotted(Hrs) For *	Time Allotted For Rest Branches
1	16	19
2	16	19
3	16	19
4	16	19
5	16	0
6	16	20
Total	96	96

Note: *- Smithy Shop will be taught only to branches Automobile Engineering, Agriculture Engineering, Civil Engineering, Mechanical Engineering, Mechanical Engineering (Refrigeration and Air Conditioning) and Mechanical Engineering(Tool & Die).

Applied Physics-I Labs

Course Code	:	BS107
Course Title	:	Applied Physics-I Labs
Number of Credits	:	1 (L: 0,DCS:0,P: 2)
Prerequisites	:	NIL
Course Category	:	BS

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.

List of Practical's/Activities (To perform minimum 08 practicals).

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 find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook's Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the coefficient of linear expansion of the material of a rod.
10. To determine atmospheric pressure at a place using Fortin's barometer.
11. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

Course Outcomes:

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

- Select right kind of measuring tools (Meter scale, Vernier caliper, Screwgauge, 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 co-efficient of friction between different surfaces.
- Describe and verify Hook'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 how materials expand on heating and determine linear expansion coefficient for a given material rod.
- Understand working and use of 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.

References:

1. Text Book of Physics for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi.
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P)Ltd.
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. e-books/e-tools/ learning physics software/YouTube videos/websites etc.

APPLIED CHEMISTRY LAB (BS109)

Course Code	:	BS109
Course Title	:	Applied Chemistry Lab
Number of Credits	:	1 (L: 0,DCS:0, P: 2)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives:

There are numerous number 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.

LIST OF PRACTICALS:

1. Preparation of standard solution of oxalic acid.
2. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3. Experimental verification of Faraday's first law of Electrolysis using Copper sulphate solution and Copper electrodes.

OR

To construct and measure emf of Electro Chemical cell (Daniel cell).

4. Iodometric estimation of Copper in the given Copper ore using standard Hypo solution.

OR

To determine the percentage of Iron present in the given Haematite ore by standard Potassium permanganate solution.

5. To estimate of hardness of water using standard EDTA solution and Eriochrome black indicator and neutral buffer solution(pH range 7-11).

OR

To estimate total alkalinity of given water sample by titrating it against standard Sulphuric acid solution.

6. To estimate moisture in given coal sample gravimetrically.
7. To estimate ash in given coal sample gravimetrically.
8. To determine viscosity of given lubricating oil by Redwood viscometer.

Reference Books:

1. Text Book of Chemistry for Class XI & XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2. Dr. G. H. Hugar and Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
3. Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.
4. Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015

Course 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.
- To construct different electrochemical cells used in developing batteries

Sports and Yoga (HS103)

Course Code	:	HS103
Course Title	:	Sports and Yoga
Number of Credits	:	1(L:0,DCS:0,P:2)
Prerequisites	:	NIL
Course Category	:	HS

Course Objectives:

- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Content:

- **Introduction to Physical Education**
 - Meaning & definition of Physical Education.
 - Aims & Objectives of Physical Education.
 - Changing trends in Physical Education.
- **Olympic Movement**
 - Ancient & Modern Olympics (Summer & Winter.)
 - Olympic Symbols, Ideals, Objectives & Values.
 - Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhyanchand Award, Rajiv Gandhi Khel Ratna Award etc.).
- **Physical Fitness, Wellness & Lifestyle**
 - Meaning & Importance of Physical Fitness & Wellness.
 - Components of Physical fitness.
 - Components of Health related fitness.
 - Components of wellness.
 - Preventing Health Threats through Lifestyle Change.
 - Concept of Positive Lifestyle.

- **Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**
 - Define Anatomy, Physiology & Its Importance.
 - Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.).
- **Kinesiology, Biomechanics & Sports**
 - Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports.
 - Newton's Law of Motion & its application in sports.
 - Friction and its effects in Sports.
- **Postures**
 - Meaning and Concept of Postures.
 - Causes of Bad Posture.
 - Advantages & disadvantages of weight training.
 - Concept & advantages of Correct Posture.
 - Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
 - Corrective Measures for Postural Deformities.
- **Yoga**
 - Meaning & Importance of Yoga.
 - Elements of Yoga.
 - Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
 - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Sha-shankasana).
 - Relaxation Techniques for improving concentration Yognidra.
- **Yoga & Lifestyle**
 - Asanas as preventive measures.
 - Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
 - Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
 - Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
 - Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.

- Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.
- **Training and Planning in Sports**
 - Meaning of Training.
 - Warming up and limbering down.
 - Skill, Technique & Style.
 - Meaning and Objectives of Planning.
 - Tournament – Knock-Out, League/Round Robin & Combination.
- **Psychology & Sports**
 - Definition & Importance of Psychology in Physical Edu. & Sports.
 - Define & Differentiate Between Growth & Development
 - Adolescent Problems & Their Management.
 - Emotion: Concept, Type & Controlling of emotions.
 - Meaning, Concept & Types of Aggressions in Sports.
 - Psychological benefits of exercise.
 - Anxiety & Fear and its effects on Sports Performance.
 - Motivation, its type & techniques.
 - Understanding Stress & Coping Strategies.
- **Doping**
 - Meaning and Concept of Doping.
 - Prohibited Substances & Methods.
 - Side Effects of Prohibited Substances.
- **Sports Medicine**
 - First Aid – Definition, Aims & Objectives.
 - Sports injuries: Classification, Causes & Prevention.
 - Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries.
- **Sports / Games**
 - Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.
 - History of the Game/Sport.
 - Latest General Rules of the Game/Sport.

- Specifications of Play Fields and Related Sports Equipment.
- Important Tournaments and Venues.
- Sports Personalities.
- Proper Sports Gear and its Importance.

References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes).

Course Outcomes:

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

- (i) Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
- (ii) Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
- (iii) Learn breathing exercises and healthy fitness activities.
Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
- (iv) Perform yoga movements in various combination and forms.
- (v) Assess current personal fitness levels.
- (vi) Identify opportunities for participation in yoga and sports activities.
- (vii) Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
- (viii) Improve personal fitness through participation in sports and yogic activities.
- (ix) Develop understanding of psychological problems associated with the age and lifestyle.
- (x) Demonstrate an understanding of sound nutritional practices as related to health and physical performance.
- (xi) Assess yoga activities in terms of fitness value.
- (xii) Identify and apply injury prevention principles related to yoga and physical fitness activities.
- (xiii) Understand and correctly apply biomechanical and physiological principles related to exercise and training.

Communication Skills in English - Lab (HS105)

Course Code	:	HS105
Course Title	:	Communication Skills in English - Lab
Number of Credits	:	1 (L: 0, DCS-0,P: 2)
Prerequisites	:	NIL
Course Category	:	HS

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.

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

1. Sounds: consonant, vowel, diphthongs, etc. transcription of words (IPA), syllable division,
2. Word stress, intonation, voice modulation etc.

Unit III Speaking Skills

Standard and formal speech:

- Group discussion,
- Oral presentations,
- Public speaking, business presentations etc.
- Conversation practice
- Role playing,
- Mock interviews etc.

References:

1. J.D.O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 1980.
2. Lindley Murray. *An English Grammar: Comprehending Principles and Rules*. London: Wilson and Sons, 1908.
3. Kulbhushan Kumar, *Effective Communication Skills*, Khanna Publishing House, New Delhi (Revised Edition 2018).
4. Margaret M. Maison. *Examine your English*. Orient Longman: New Delhi, 1964.
5. M. Ashraf Rizvi. *Effective Technical Communication*. Mc-Graw Hill: Delhi, 2002.
6. John Nielson. *Effective Communication Skills*. Xlibris, 2008.
7. Oxford Dictionary.
8. Roget's Thesaurus of English Words and Phrases.
9. Collin's English Dictionary.

Course Outcomes:

At the end of this course, the participants will:

1. 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.
2. Be informed of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
3. Also develop skills of group presentation and communication in team.
4. Develop non-verbal communication such as proper use of body language and gestures.

Mathematics - II (BS102)

Course Code	:	BS102
Course Title	:	Mathematics - II
Number of Credits	:	4 (L: 4,DCS:1, P: 0)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives:

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

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 formulae $\int_0^{\pi/2} \sin^n x dx$, $\int_0^{\pi/2} \cos^n x dx$ and $\int_0^{\pi/2} \sin^m x \cos^n x dx$ 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 : Differential Equations

Solution of first order and first degree differential equation by variable separable method (simple problems).

References:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 40th Edition, 2007.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
3. S.S. Sabharwal, Sunita Jain, Eagle Parkashan, Applied Mathematics, Vol. I & II, Jalandhar.
4. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna PublishingHouse, New Delhi.

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.

Distribution of Time and Marks

Unit	Time (Hours)	Marks %age
1	15	20
2	30	40
3	25	30
4	10	10
Total	80	100

APPLIED PHYSICS –II (BS104)

Course Code	:	BS104
Course Title	:	Applied Physics -II
Number of Credits	:	3(L:3,DCS: 1, P:0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

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.

Course Content

UNIT - 1: Wave motion and its applications

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.

Simple Harmonic Motion (SHM): definition, expression for displacement, velocity, acceleration, time period, frequency etc.

Free, forced and resonant vibrations and their examples.

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

Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.

UNIT - 2: Optics

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.

Optical Instruments- simple and compound microscope, astronomical telescope in normal adjustment and their magnifying powers.

UNIT - 3: Electrostatics

Coulomb's law, unit of charge.

Electric field, Electric lines of force and their properties.

Electric flux, Electric potential and potential difference, Gauss's law.

Capacitor and its working, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down.

UNIT - 4: Current Electricity

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, carbon resistances and colour coding.

Ohm's law and its verification, Kirchhoff's laws.

Concept of terminal potential difference and Electro motive force (EMF)

Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.

UNIT - 5: Electromagnetism

Types of magnetic materials: dia, para and ferromagnetic with their properties.

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

Lorentz force (force on moving charge in magnetic field), Force on current carrying conductor.

Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.

UNIT - 6: Semiconductor 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.

Diode as rectifier – half wave and full wave rectifier (centre taped).

Photocells, Solar cells; working principle and engineering applications.

UNIT - 7: Modern Physics

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.

Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors.

Course Outcomes:

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 Ultrasonic. 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.
- g) Express electric current as flow of charge, concept of resistance, measure of the parameters: electric current, potential difference, resistance.
- h) List the effects of an electric current and its common applications, State Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, distinguish between AC and DC currents, determine the energy consumed by an appliance.
- i) Explain the operation of appliances like moving coil galvanometer, simple DC motors.
- j) Apply the knowledge of diodes in rectifiers, power adapters and various electronic circuits. Use the knowledge of semiconductors in various technical gadgets like mobile phones, computers, LED, photocells, solar lights etc.

k) Illustrate the conditions for light amplification in various LASER and laser based instruments and optical devices.

l) Appreciate the potential of optical fiber in fields of medicine and communication.

References:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi.
2. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
3. Concepts in Physics by HC Verma, Vol. I & II, Bharti Bhawan Ltd. New Delhi.
4. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi.
5. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
6. A Textbook of Optics, N Subramanyam, Brij Lal, MN Avahanulu, S Chand and Company Ltd.
7. Introduction to Fiber Optics, Ajoy Ghatak and K Thyagarajan, Cambridge University Press India Pvt. Ltd, New Delhi.
8. e-books/e-tools/ learning physics software/websites etc.

SUGGESTED DISTRIBUTION OF MARKS

UNIT/TOPIC	TIME ALLOTTED	MARKS ALLOTTED (%)
1	14	20
2	10	15
3	7	15
4	7	10
5	8	15
6	7	10
7	11	15
Total	64	100

Introduction to IT Systems (ES102)

Course Code	:	ES102
Course Title	:	Introduction to IT Systems
Number of Credits	:	2(L:2, DCS-0, P:0)
Prerequisites (Course Code)	:	NIL
Course Category	:	ES

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 Content:

UNIT 1: Basics of Computer System

Block Diagram of Computer System, General Understanding of various hardware components- CPU, Memory, Display Devices (CRT and LCD Monitors), Keyboard, Mouse, HDD.

UNIT 2: Software Concepts

Software and its types, Operating System: Definition, types and function of Operating System, Booting the system (Cold and warm).

UNIT 3: Internet Skills

Understanding the terminology of internet-web browser, search engine, world wide web, Types of Networks. Awareness about the government portals (state portals and national portals) and institute portals.

UNIT 4: Working with MS- Word

File Management (Creating new document, saving a document, printing a document), Editing a document, use of Home, Insert, Design Layout ribbons.

UNIT 5: Working with MS- Excel

Working with spread sheets, entering data into the cells, merging cells, formula bar, usage of simple functions such as sum, average, min, max, percentage, round, floor, ceiling, conditional formatting of cells.

UNIT 6: Information Security

Concept of online frauds, threats of online crime, virus attacks and use of antivirus.

Reference Books

- R.S. Salaria, Computer Fundamentals, Khanna Publishing House.
- Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi.
- Information Technology for Management by Henery Lucas, Tata McGraw Hills, New Delhi.
- Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi.

Course Outcomes:

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted(Hrs)	Marks Alotted
1	7	25
2	5	15
3	7	20
4	5	15
5	5	15
6	3	10
Total	32	100

FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING (ES104)

Course Code	:	ES104
Course Title	:	FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING
Number of Credits	:	3 (L:3, DCS:1 ,P:0)
Prerequisites	:	NIL
Course Category	:	ES

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 Content:

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, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.

UNIT II Overview of Analog Circuits: Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator.

UNIT III Overview of Digital Electronics: Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).

Unit IV Electric and Magnetic Circuits: EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve; 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 V: A.C. Circuits: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf

and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

Unit VI Transformer and Machines: General construction and principle of core and shell type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Basic principle of Electromechanical energy conversion.

Course Outcomes:

At the end of the course student will be able to

- To express different elements and concepts of electrical engineering field
- To understand basic concepts of various active and passive electronic components, Signals, Op-Amp
- To use Digital Electronics and their applications

SUGGESTED DISTRIBUTION OF MARKS

Units	Time Allotted (Hour)	Marks Allotted (%)
Unit-I	12	15
Unit-II	8	10
Unit-III	10	20
Unit-IV	12	20
Unit-V	14	25
Unit-VI	8	10
Total	64	100

Engineering Mechanics (ES 106)

Course Code	:	ES 106
Course Title	:	Engineering Mechanics
Number of Credits	:	3 (L: 3,DCS:1, P: 0)
Prerequisites	:	NIL
Course Category	:	ES

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 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 and Free body diagram, Analytical and graphical methods of analyzing equilibrium.

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

problems. Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical point load, uniformly distributed load), Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and uniformly distributed load.

Beam reaction graphically for simply supported beam subjected to vertical point loads only.

Unit– III Friction

Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction.

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

Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.

Unit– IV Centroid and centre of gravity

Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle).

Centroid of composite figures composed of not more than two geometrical figures.

Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere)

Centre of Gravity of composite solids composed of not more than two simple solids.

Unit – V Simple lifting machine

Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine.

Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, conditions for reversibility.

Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Simple screw jack.

Suggested Learning Resources:

1. D.S. Bedi, Engineering Mechanics, Khanna Publications, New Delhi (2008)
2. Khurmi, R.S., Applied Mechanics, S. Chand & Co. New Delhi.
3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S. Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune VidhyarthiGruh.
6. Ram, H. D.; Chauhan, A. K., Foundations and Applications of Applied Mechanics, Cam-bridge University Press.
7. Meriam, J. L., Kraige, L.G., Engineering Mechanics- Statics, Vol. I, Wiley Publication, NewDelhi.

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.

Suggested Distribution of Time & Marks

Units	Time Allotted (Hour)	Weightage (%)
I	13	20
II	13	20
III	12	20
IV	13	20
V	13	20
Total	64	100

Applied Physics-II Labs (BS 106)

Course Code	:	BS 106
Course Title	:	Applied Physics II Lab
Number of Credits	:	1 (L: 0,DCS:0, P: 2)
Prerequisites	:	NIL
Course Category	:	BS

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.

List of Practical's/Activities: (To perform minimum 08 Practical's)

1. To determine and verify the time period of a cantilever.
2. To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.
3. To verify laws of reflection from a plane mirror/ interface.
4. To verify laws of refraction (Snell's law) using a glass slab.
5. To determine focal length and magnifying power of a convex lens.
6. To verify Ohm's law by plotting graph between current and potential difference.
7. To verify laws of resistances in series and parallel combination.
8. To verify Kirchhoff's laws using electric circuits.
9. To study the dependence of capacitance of a parallel plate capacitor on various factors and determine permittivity of air at a place.
10. To find resistance of a galvanometer by half deflection method.
11. To convert a galvanometer into an ammeter.
12. To convert a galvanometer into a voltmeter.
13. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.

14. To verify inverse square law of radiations using a photo-electric cell.
15. To measure wavelength of a He-Ne/diode laser using a diffraction grating.
16. To measure numerical aperture (NA) of an optical fiber.

Course Outcomes:

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) Analyze electrical circuits and verify Kirchhoff's law governing electrical circuits.
- h) Measure resistance of a galvanometer and how it is converted into an ammeter and voltmeter.
- i) Investigate characteristics of semiconductor diodes, photoelectric cells and determine operational parameters associated with their performance.
- j) Work with laboratory lasers and understand method to measure the wavelength of the light emitted from a laser.
- k) Handle optical fibers and determine numerical aperture of given optical fiber.

Recommended Books:

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi.
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi.
3. Practical Physics by C. L. Arora, S. Chand & Company Ltd.
4. e-books/e-tools/ learning physics software/you Tube videos/ websites etc.

Introduction to IT Systems Lab (ES 108)

Course Code	:	ES 108
Course Title	:	Introduction to IT Systems Lab
Number of Credits	:	2 (L:0,DCS:0, P:4)
Prerequisites (Course Code)	:	NIL, should be doing ES102 in parallel
Course Category	:	ES

Course Objectives:

This lab course is intended to practice whatever is taught in theory class of “Introduction to IT Systems” and become proficient in using computer environment- basic computer skills, basic application software tools, computer hardware, cyber security features.

Course Content:

Sr. No.	Topics For Practice
1	To identify the various hardware components of computer system.
2	To assemble hardware components of Computer System.
3	To install Windows OS on computer system.
4	To study the various features offered on the desktop, creating new folder and new file on the desktop.
5	To work on different web browsers(google chrome , internet explorer), setting up default homepage on browser and study the various settings available.
6	To open search engines (google and yahoo) and search different information using the search engines. Creating an e-mail Account.
7	Visit various e-governance/digital India Portals and understanding the services offered.
8	Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file, Setting margins, tab setting, ruler, indenting, Entering text, cut, copy, paste using tool- bars.
9	Formatting a document, Creating and editing tables, mail-merge.
10	Working on MS – EXCEL- Creating a worksheet in Excel. Copy, Move and Merge the cells and Use various Formatting features.
11	Using formula and functions prepare worksheet for storing subject marks of ten students and perform the following: <ul style="list-style-type: none"> ➤ Calculate the student wise total and average. ➤ Calculate the subject wise total and average. ➤ Calculate the overall percentage and also individual percentage of the student. ➤ Create a chart for the above.

References:

1. Online resources, Linux man pages, Wikipedia.
2. R.S. Salaria, Computer Fundamentals, Khanna Publishing House.
3. Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.
4. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett.
5. IT Essentials PC Hardware and Software Companion Guide, Davis Anfinson and Ken Quamme, CISC Press, Pearson Education.
6. PC Hardware and A+ Handbook, Kate J. Chase PHI (Microsoft).

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.

Fundamentals of Electrical and Electronics Engineering Lab (ES110)

Course Code	:	ES110
Course Title	:	Fundamentals of Electrical and Electronics Engineering Lab
Number of Credits	:	1 (L: 0, DCS:0,P: 2)
Prerequisites	:	NIL
Course Category	:	ES

Practicals/ Exercises:

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs.
1.	Determine the permeability of magnetic material by plotting its B-H curve.	02*
2.	Measure voltage, current and power in 1-phase circuit with resistive load.	02*
3.	Measure voltage, current and power in R-L series circuit.	02*
4.	Determine the transformation ratio (K) of 1-phase transformer.	02
5.	Connect single phase transformer and measure input and output quantities.	02
6.	Make Star and Delta connection in induction motor starters and measure the line and phase values.	02
7.	Identify various passive electronic components in the given circuit.	02
8.	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	02
9.	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	02*
10.	Identify various active electronic components in the given circuit.	02
11.	Use multimeter to measure the value of given resistor.	02
12.	Use LCR-Q tester to measure the value of given capacitor and	02
13.	Determine the value of given resistor using digital multimeter to confirm with colour code.	02*
14.	Test the PN-junction diodes using digital multimeter.	02*
15.	Test the performance of PN-junction diode.	02
16.	Test the performance of Zener diode.	02
17.	Test the performance of LED.	02
18.	Identify three terminals of a transistor using digital multimeter.	02

19.	Test the performance of NPN transistor.	02*
20.	Determine the current gain of CE transistor configuration.	02
21.	Test the performance of transistor switch circuit.	02
22.	Test the performance of transistor amplifier circuit.	02
23.	Test Op-Amp as amplifier and Integrator.	02
	Total	46

References:

1. Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House, 2018.
2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN : 978-0-07-0088572-5.
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353.
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand publications, New Delhi, 2015, ISBN:9788121924405.
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand publications, New Delhi, 2015, ISBN:9788121924375.
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513.
7. Sedha, R.S., A text book of Applied Electronics, S.Chand ,New Delhi, 2008, ISBN-13: 978-8121927833.
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Eduction, New Delhi,2015,ISBN-13: 0070634244-978.
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014,ISBN-13-9788121924504.
10. Bell Devid, Fundamental of Electronic Devices and Circuits, Oxford University Press, New Delhi 2015 ISBN : 9780195425239.

Suggested Softwares/Learning Websites:

- a. en.wikipedia.org/wiki/Transformer
- b. www.animations.physics.unsw.edu.au/~jw/AC.html
- c. www.alpharubicon.com/altenergy/understandingAC.htm
- d. www.electronics-tutorials
- e. learn.sparkfun.com/tutorials/transistors
- f. www.pitt.edu/~qiw4/Academic/ME2082/Transistor%20Basics.pdf
- g. www.technologystudent.com/elec1/transis1.htm
- h. www.learningaboutelectronics.com
- i. www.electrical4u.com

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 waveforms.
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.

Engineering Mechanics Lab(ES 112)

Course Code	:	ES 112
Course Title	:	Engineering Mechanics Lab
Number of Credits	:	1 (L: 0,DCS:0, P: 2)
Prerequisites	:	NIL
Course Category	:	ES

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.

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 Differential Axle and Wheel.
3. To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
4. Derive Law of machine using Worm and worm wheel.
5. Determine resultant of concurrent force system applying Law of Polygon of forces using forcetable.
6. Determine resultant of concurrent force system graphically.
7. Determine resultant of parallel force system graphically.
8. Verify Lami's theorem.
9. Study forces in various members of Jib crane.
10. Determine support reactions for simply supported beam.
11. Obtain support reactions of beam using graphical method.
12. Determine coefficient of friction for motion on horizontal and inclined plane.
13. Determine centroid of geometrical plane figure.

Suggested Learning Resources:

1. Bedi D.S., Engineering Mechanics, Khanna Publishing House
2. Khurmi, R.S., Applied Mechanics, S.Chand & Co. New Delhi.

3. Bansal R K, A text book of Engineering Mechanics, Laxmi Publications.
4. Ramamrutham, Engineering Mechanics, S.,S Chand & Co. New Delhi.
5. Dhade, Jamadar & Walawelkar, Fundamental of Applied Mechanics, Pune Vidhyarthi Gruh.
6. Ram, H. D.; Chauhan, A. K. Foundations and Applications of Applied Mechanics, Cambridge University Press.
7. Meriam, J. L., Kraige, L.G. , Engineering Mechanics- Statics, Vol. I, Wiley Publication, New Delhi.

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.

Environmental Science (AU102)

Course Code	:	AU102
Course Title	:	Environmental Science
Number of Credits	:	0 (non-credit) (L: 2, DCS-0, P:0)
Prerequisites	:	High School Science
Course Category	:	AU

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 Content:

Pre requisite: - High School Chemistry.

Unit-1 Ecosystem

Structure of ecosystem, Biotic & Abiotic components Food chain and food web Aquatic (Lentic and Lotic) and terrestrial ecosystem Carbon, Nitrogen, Sulphur, Phosphorus cycle. 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 (Refrigerants, I.C., Boiler) ,Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator).

Gaseous Pollution Control: Absorber, Catalytic Converter, Effects of air pollution due to Refrigerants, I.C., Boiler.

Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000.

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, calculation.

Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis).

Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.

Unit– 4 Renewable sources of Energy

Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills.

Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. 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.

Unit-5 Solid Waste Management, ISO 14000 & Environmental Management

Solid waste generation- Sources and characteristics of: Municipal solid waste, E- waste, bio- medical waste. Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.

Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous.

Waste Air quality act 2004, air pollution control act 1981 and water pollution and control act 1996. Structure and role of Central and state pollution control board.

Concept of Carbon Credit, Carbon Footprint. Environmental management in fabrication industry. ISO 14000: Implementation in industries, Benefits.

References:

(a) Suggested Learning Resources:

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.
3. Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and.
4. Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-

5. Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000, ISBN 10: 0471144940.
6. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi.
7. Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
8. Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07-451871-8.
9. Frank Kreith, Jan F Kreider, Principles of Solar Engineering, McGraw-Hill, New York ; 1978, ISBN: 9780070354760.
10. Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford, UK; 2013. ISBN: 9780123978257.
11. Patvardhan, A.D, Industrial Solid Waste, Teri Press, New Delhi, 2013, ISBN:978-81-7993-502-6.
12. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
13. Keshav Kant, Air Pollution & Control, Khanna Publishing House, New Delhi (Edition 2018).

(b) Open source software and website address:

- 1) www.eco-prayer.org
- 2) www.teriin.org
- 3) www.cpcp.nic.in
- 4) www.cpcp.gov.in
- 5) www.indiaenvironmentportal.org.in
- 6) www.whatis.techtarget.com
- 7) www.sustainabledevelopment.un.org
- 8) www.conserve-energy-future.com

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.

Suggested Distribution of Time & Marks

Units	Time Allotted (Hour)	Weightage (%)
I	6	20
II	6	20
III	6	20
IV	6	20
V	8	20
Total	32	100

CURRICULUM

For

DIPLOMA PROGRAMME

in

MECHANICAL ENGINEERING

2nd Year (3rd & 4th Semester)

FOR THE STATE OF HIMACHAL PRADESH



Prepared by

Composite Curriculum Development Centre

Directorate of Technical Education,

Vocational & Industrial Training, Sundernagar (H.P.)

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THREE YEAR DIPLOMA
IN
MECHANICAL ENGINEERING

SALIENT FEATURES

Programme	Diploma in Mechanical Engineering
Duration	Three years (Six Semesters)
Entry Qualification	As prescribed by H.P. Takniki Shiksha Board /AICTE
Intake	As approved by H.P. Takniki Shiksha Board
Pattern	Semester System

Definition of Credit:

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

Course code and definition:

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

List of Programme Core Courses [PC]

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	DCS	P		
1	MEPC201	Basic Mechanical Engineering	3	1	0	III	3
2	MEPC203	Material Science & Engineering	3	1	0	III	3
3	MEPC205	Measurements & Metrology	3	1	0	III	3
4	MEPC207	Manufacturing Engineering	3	1	0	III	3
5	MEPC209	Thermal Engineering-I	3	1	0	III	3
6	MEPC211	Manufacturing Engineering Lab-I	0	2	4	III	2
7	MEPC213	Measurements & Metrology Lab	0	0	2	III	1
8	MEPC215	Thermal Engineering Lab-I	0	0	2	III	1
9	MEPC202	Strength of Materials	3	1	0	IV	3
10	MEPC204	Thermal Engineering-II	3	1	0	IV	3
11	MEPC206	Material Testing Lab	0	0	2	IV	1
12	MEPC208	Computer Aided Machine Drawing Practice	0	0	4	IV	2
13	MEPC210	Thermal Engineering Lab-II	0	0	2	IV	1
14	MEPC212	Manufacturing Engineering Lab-II	0	0	4	IV	2
Total Credits							31

List of Program Elective Courses [PE]

S. No	Code No.	Course Title	Hours per week		Semester	Credits
			L	P		
1	MEPE202-1	Tool Engineering	3	0	IV	3
2	MEPE202-2	Industrial Robotics & Automation	3	0	IV	3
3	MEPE202-3	Automobile Engineering	3	0	IV	3
4	MEPE204-1	Power Plant Engineering	3	0	IV	3
5	MEPE204-2	Production & Operations Management	3	0	IV	3
6	MEPE204-3	Industrial Engineering & Management	3	0	IV	3
Total Credits						6

Note: MEPE### - # to be assigned as per the course offered in a particular semester

PROGRAMME OUTCOMES (POs)

P01	Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
P02	Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.
P03	Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
P04	Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
P05	Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.
P06	Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities
P07	Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

Programme: Programme means Diploma Programme that is Diploma in Mechanical Engineering, which is of three years duration.

PROGRAMME SPECIFIC OUTCOMES (PSO's)

On satisfactory completion of the program, a student should able to:

PSO Designation number	Type	Description
PSO 1	Specialization knowledge	Identify, analyze and solve real-life problems by applying the knowledge in Mechanical Engineering.
PSO 2	Employability	Plan and develop mechanical systems and intelligent tools to excel in the field of Mechanical engineering with an aspire to become a brand name in industry and society.
PSO 3	Ethics and Values	Find solutions to global issues faced by the society through engineering and technology innovations by upholding professional ethics and social values.

STUDY AND EVALUATION SCHEME
SEMESTER WISE DETAILED CURRICULUM
SEMESTER III

S.NO	CATEGORY	CODE NO.	COURSE TITLE	HOURS PER WEEK			TOTAL CONTACT HRS/WEEK	CREDIT	MARKS IN EVALUATION SCHEME							TOTAL MARKS	
				L	DCS	P			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
									TH	PR	TOTAL	TH	HRS	PR	HRS		TOTAL
1	Program core course	MEPC201	# BASIC MECHANICAL ENGINEERING	3	1	0	4	3	40		40	60	3			60	100
2	Program core course	MEPC203	## MATERIAL SCIENCE & ENGINEERING	3	1	0	4	3	40		40	60	3			60	100
3	Program core course	MEPC205	### MEASUREMENT & METROLOGY	3	1	0	4	3	40		40	60	3			60	100
4	Program core course	MEPC207	#MANUFACTURING ENGINEERING	3	1	0	4	3	40		40	60	3			60	100
5	Program core course	MEPC209	THERMAL ENGINEERING I	3	1	0	4	3	40		40	60	3			60	100
6	Program core course	MEPC211	MANUFACTURING ENGINEERING LAB1	0	2	4	6	2		40	40			60	3	60	100
7	Program core course	MEPC213	MEASUREMENT & METROLOGY LAB	0	0	2	2	1		40	40			60	3	60	100
8	Program core course	MEPC215	THERMAL ENGINEERING LAB 1	0	0	2	2	1		40	40			60	3	60	100
9			SCA	.....	.....	2	2	.....		25	25						25
TOTAL				15	7	10	32	19	200	145	345	300		180		480	825

* The students shall undergo Internship-I at the end of 3rd semester (During semester break after board examinations of duration 04 weeks) which will be evaluated and reflected in study and evaluation scheme of 4th semester.

#Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechatronics.

Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechanical Engineering (Tool & Die).

Common with diploma in Mechanical Engineering (Tool & Die).

**STUDY AND EVALUATION SCHEME
SEMESTER WISE DETAILED CURRICULUM**

SEMESTER IV

S.N O	CATEGORY	CODE NO.	COURSE TITLE	HOURS PER WEEK			TOTAL CONTACT HRS/WEEK	CREDIT	MARKS IN EVALUATION SCHEME							TOTAL MARKS	
				L	DCS	P			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
									TH	PR	TOTAL	TH	HRS	PR	HRS		TOTAL
1	Program core course	MEPC202	# STRENGTH OF MATERIALS	3	1	0	4	3	40		40	60	3			60	100
2	Program core course	MEPC204	THERMAL ENGINEERING II	3	1	0	4	3	40		40	60	3			60	100
3	Program Elective core course	MEPE###	#MEPE202-1: Tool Engineering , ##MEPE202-2:Industrial robotics & Automation or ##MEPE202-3: Automobile Engineering	3	0	0	3	3	40		40	60	3			60	100
4	Program Elective core course	MEPE###	###MEPE204-1: Power Plant Engineering, ##MEPE204-2: Production & Operation management or MEPE204-3: Industrial Engineering & Management	3	0	0	3	3	40		40	60	3			60	100
5	Program core course	MEPC206	MATERIAL TESTING LAB	0	0	2	2	1		40	40			60	3	60	100
6	Program core course	MEPC208	COMPUTER AIDED MACHINE DRAWING PRACTICE	0	0	4	4	2		40	40			60	3	60	100
7	Program core course	MEPC210	THERMAL ENGINEERING LAB II	0	0	2	2	1		40	40			60	3	60	100
8	Program core course	MEPC212	MANUFACTURING ENGINEERING LAB II	0	0	4	4	2		40	40			60	3	60	100
9	Minor Project	PR202	MINOR PROJECT	0	0	4	4	2		40	40			60	3	60	100
10	Mandatory Course	AU202	ESSENCE OF INDIAN KNOWLEDGE AND TRADITIONS	2	0	0	2	0	40		40	60	3			60	100
11	Internship I (4 weeks) after 3rd sem.	SI-1	INTERNSHIP-1	0	0	0	0	2		40	40			60	3	60	100
12			SCA	....	...	2	2			25	25						25
	TOTAL			14	2	18	34	22	200	265	465	300		360		660	1125

* The students shall undergo Internship-II at the end of 4th semester (During semester break after board examinations of duration 06 weeks) which will be evaluated and reflected in study and evaluation scheme of 5th semester.

Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechanical Engineering (Tool & Die).

Common with diploma in Mechanical Engineering (Tool & Die).

Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning)

DETAILED CONTENTS

(Programme Core Courses)

Semester III

Course Code	:	MEPC201
Course Title	:	BASIC MECHANICAL ENGINEERING
Number of Credits	:	3 (L:3, DCS:1 ,P:0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

- To understand General Principles of Mechanical Engineering.
- To understand laws of thermodynamics, thermal and thermodynamic Processes.
- To understand working principles of power developing and power absorbing devices.
- To understand basic materials and manufacturing processes.

Course Content:

UNIT-I: (14Hrs)

Introduction to Thermodynamics - Role of Thermodynamics in Engineering and science, Types of Systems, Thermodynamic Equilibrium, Properties, State, Process and Cycle, Elementary introduction to Zeroth, First and Second laws of thermodynamics, Heat and Work Interactions for various processes; Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/COP; Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, T-S and P-V Diagrams, Concept of Entropy

Unit-II: (14Hrs)

Heat transfer & Thermal Power Plant: Heat Transfer, Modes of Heat Transfer; Conduction: Fourier Equation, Conduction heat transfer through Composite Walls, Simple Numerical Problems, Convection Heat transfer: : Natural and forced convection, Radiation: Absorption, Reflection and transmission of radiation, Concept of black body, Stefan-Boltzman Law (concept only , No derivation), Thermal Power Plant Layout; Rankine Cycle; Fire Tube and Water Tube boilers, Babcock& Wilcox, Cochran Boilers

Unit-III: (12Hrs)

Steam Turbines: Impulse and Reaction Turbines; Condensers: Jet & Surface Condensers, Cooling Towers;
Internal Combustion Engines: Otto, Diesel and Dual cycles; P-V and T-S Diagrams; IC Engines:2-Stroke and 4-Stroke I.C. Engines, S.I. and C.I. Engines.

Unit-IV: (12Hrs)

Materials and Manufacturing Processes (derivations and Problems omitted): Engineering Materials, Classification and their Properties; Metal Casting, Moulding, Patterns, Metal Working: Hot Working and Cold Working, Metal Forming: Extrusion, Forging, Rolling, Drawing, Gas Welding, Arc Welding, Soldering, and Brazing.

Unit-V: (12Hrs)

Machine Tools and Machining Processes: Machine Tools: Lathe Machine and types, Lathe Operations, Milling Machine and types, Milling Operations, Shaper and Planer Machines: Differences, Quick Return Motion Mechanism , Drilling Machine: Operations, Grinding Machine: Operations

Reference Books:

1. Basic Mechanical Engineering– M.P.Poonia & S.C. Sharma, Khanna Publishing House, Delhi
- 2.Elements of Mechanical Engineering– M.L. Mathur, F.S.Mehta and R.P. Tiwari, Jain Brothers, New Delhi
3. Engineering Heat Transfer–Gupta & Prakash, Nem Chand & Brothers, New Delhi
4. Workshop Technology (Vol.1and2)– B.S. Raghuvanshi, Dhanpath Rai and Sons, New Delhi.
5. Basic Mechanical Engineering–J Benjamin
6. Elements of Mechanical Engineering–Roy and Choudhary
7. Engineering Thermodynamics–Spalding and Cole

Course outcomes:

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

C01	Understand basics of thermodynamics and components of a thermal power plant
C02	Understand basics of heat transfer, refrigeration and internal combustion engines
C03	Understand mechanism of thermal power plant and boiler operation
C04	Identify engineering materials, their properties, manufacturing methods encountered in engineering practice
C05	Understand functions and operations of machine tools including milling, shaping, grinding and lathe machines

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	12
2	14	12
3	12	12
4	12	12
5	12	12
Total	64	60

* Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechatronics.

Course Code	:	MEPC203
Course Title	:	MATERIAL SCIENCE & ENGINEERING
Number of Credits	:	3 (L:3 , DCS:1, P:0)
Pre requisites	:	NIL
Course Category	:	PC

Course Objectives:

- To understand crystal structures and atomic bonds.
- To understand the properties of different types of ferrous metals and alloys.
- To understand the properties of different types of non-ferrous metals and alloys.
- To understand various metallic failures and acquire the knowledge of testing of materials.
- To understand the concept of corrosion and its prevention.

Course Content:

UNIT-I: (15Hrs)

Crystal structures and Bonds: Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for metallic elements: BCC, FCC and HCP; Coordination number for Simple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC (Formula for the above terms without Derivation); Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP (derivations omitted)

Bonds in solids: Classification-primary or chemical bond, secondary or molecular bond; Concept of Types of primary bonds: Ionic, Covalent and Metallic Bonds.

Unit-II: (15Hrs)

Phase diagrams, Ferrous metals and its Alloys: Introduction of Isomorphs, eutectic and eutectoid systems; Iron-Carbon binary diagram; Iron and Carbon Steels; Iron ores–Pig iron: classification, composition and effects of impurities on iron ; Cast Iron: classification, composition, properties and uses; Wrought Iron: properties, uses/applications of wrought Iron; standard commercial grades of steel as per BIS and AISI; Alloy Steels – purpose of alloying; effects of alloying elements, Important alloy steels: Silicon steel, High Speed Steel(HSS),heat resisting steel, spring steel, Stainless Steel(SS)

Unit-III: (12Hrs)

Non-ferrous metals and its Alloys: Properties and uses of aluminum, copper, tin, lead, zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminum alloys: Duralumin, hinalium, magnelium – composition, properties and uses; Nickel alloys: Inconel, monel, nicrome – composition, properties and uses. Anti-friction/Bearing alloys: Various types of bearing, bronzes-Standard commercial grades as per BIS/ASME.

Unit-IV: (12Hrs)

Failure analysis & Testing of Materials: Introduction to failure analysis;Fracture: ductile fracture, brittle fracture; cleavage; notch sensitivity; fatigue; concept of endurance limit; concept of creep; creep curve; creep fracture; Destructive testing: Tensile testing; compression testing; Hardness testing: Brinell, Rockwell; bend test; torsion test; fatigue test; creep test; Non-destructive testing: Visual Inspection; magnetic particle inspection; liquid penetrant test; ultrasonic inspection; radiography.

Unit-V: (10Hrs)

Corrosion & Surface Engineering: Nature of corrosion and its causes;;Electrolytes; Factors affecting corrosion: Environment, Material properties and physical conditions; Types of corrosion; Corrosion control: Material selection, environment control; Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Electroplating and Special metallic plating; Electro polishing and photo-etching;–Conversion coatings: Oxide, phosphate and chromate coatings; Thin film coatings: PVD and CVD; Hard-facing, thermal spraying and high-energy processes.

Reference Books:

1. A Text Book of Material Science & Metallurgy –O.P. Khanna, Dhanpath Rai and Sons, New Delhi. 2003.
2. Material Science & Engineering– R.K.Rajput, S.K.Kataria & Sons, New Delhi, 2004.
3. Material Science–R.S. Khurmi, S.Chand & Co. Ltd., New Delhi, 2005.

Course outcomes:

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

C01	Explain about crystal structures and atomic bonds.
C02	Describe about classification of ferrous metals and their properties.
C03	Explain about non-ferrous metals, cutting tool materials and composites along With their properties.
C04	Describe about the various metallic failures and knowledge in testing of materials.
C05	Explain the principle of corrosion, their types and its prevention methods along With the various surface engineering processes.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	15	14
2	15	14
3	12	12
4	12	10
5	10	10
Total	64	60

* Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechanical Engineering (Tool & Die).

Course Code	:	MEPC205
Course Title	:	MEASUREMENTS & METROLOGY
Number of Credits	:	3 (L: 3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

- To study advances in technology, measurement techniques, types of instrumentation devices, innovations, refinements.
- To study the principles of instrumentation, transducers & measurement of non-electrical parameters like temperature, pressure, flow, speed, force and stress.

Course Content:

UNIT-I:

(14Hrs)

Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect; Generalized measuring system; Standards of measurements: Primary & Secondary; Factors influencing selection of measuring instruments; Terms applicable to measuring instruments: Precision and Accuracy, Sensitivity and Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random error. (introduction only)

Measuring instruments: Introduction; Thread measurements: Thread gauge micrometer; Angle measurements: Bevel protractor, Sine Bar; Gauges: plain plug gauge, ring Gauge, snap gauge, limit gauge; Comparators: Characteristics of comparators, Types of comparators; Surface finish: Definition, Terminology of surface finish, Taly surf surface roughness tester; Coordinating measuring machine.

Unit-II:

(12Hrs)

Transducers and Strain gauges: Introduction; Transducers: Characteristics, classification of transducers, Strain Measurements (concept only) Strain gauge, Classification, mounting of strain gauges, (Theoretical aspects)

Measurement of force, torque, and pressure (derivations omitted): Introduction; Force measurement: Spring Balance, Load cell; Torque measurement: Prony brake, Eddy current, Hydraulic dynamometer; Pressure measurement: Mcloed gauge.

Unit-III:

(12Hrs)

Applied mechanical measurements: Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Displacement measurement: Linear variable Differential transformers (LVDT); Flow measurement: Rotometers, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer.

Miscellaneous measurements (Problems omitted): Humidity measurement: hair hygrometer; Density measurement: hydrometer; Liquid level measurement, sight glass, Float gauge.

Unit-IV:

(14Hrs)

Limits, Fits & Tolerances: Concept of Limits, Fits, and Tolerances; Selective Assembly; Interchangeability; Hole And Shaft Basis System; Taylor's Principle.

Angular Measurement: Concept; Instruments For Angular Measurements; Working and Use of Universal Bevel Protractor, Sine Bar, Spirit Level; Principle of Working of Clinometers; Angle Gauges.

Screw thread Measurements: ISO grade and fits of thread; Errors in threads; Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch; Two wire method; Thread gauge micrometer; Working principle of floating carriage dial micrometer.

Unit-V:

(12Hrs)

Gear Measurement and Testing: Analytical and functional inspection; Rolling test; Measurement of tooth thickness; Gear tooth Vernier; Errors in gears such as backlash, run out, composite.

Machine tool testing: Parallelism; Straightness; Squareness; Coaxiality; roundness; run out; alignment testing of machine tools as per IS standard procedure.

Reference Books:

1. Mechanical measurements–Beck with Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement–Anand K Bewoor, Vinay kulakarni, Tata McGraw Hill, New Delhi, 2009
3. Principles of Industrial instrumentation and control systems–Channakesava. R . Alavala, DELMAR cenagelearning, 2009.
4. Principles of Engineering Metrology–Rega Rajendra, Jai co publishers, 2008
5. Dimensional Metrology–Connie Dotson, DELMAR, Cenagelearning, 2007
6. Instrumentation measurement and analysis–B.C.Nakara, K.K.Chaudary, second edition, Tata mc graw Hill, 2005.
7. Engineering Metrology–R.K.Jain, Khanna Publishers, New Delhi, 2005.
8. A text book of Engineering Metrology–I.C.Gupta, Dhanpat Rai and Sons, New Delhi, 2005
9. Metrology for Engineers–J.F.W. Galyer and C.R. Shotbolt, ELDCS
10. Engineering Metrology–K.J.Hume, Kalyani publishers

Course outcomes

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

C01	Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.
C02	Distinguish between various types of errors.
C03	Understand the principle of operation of an instrument and select suitable measuring device for a particular application.
C04	Appreciate the concept of calibration of an instrument.
C05	Analyze and interpret the data obtained from the different measurements processes and present it in the graphical form, statistical form.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	12
2	12	12
3	12	12
4	14	12
5	12	12
Total	64	60

* Common with diploma in Mechanical Engineering (Tool & Die).

Course Code	:	MEPC207
Course Title	:	MANUFACTURING ENGINEERING
Number of Credits	:	3 (L: 3, DCS:1, P:0)
Prerequisites	:	Basic Mechanical Engineering
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 and understand various die operations.
- To understand Grinding and finishing processes.

Course Content:

UNIT-I:

(12Hrs)

Cutting Fluids & Lubricants: Introduction; Types of cutting fluids, Fluids and coolants required in turning, drilling, shaping, sawing & broaching; Selection of cutting fluids, methods of application of cutting fluid; Classification of lubricants (solid, liquid, gaseous), Properties and applications of lubricants.

Lathe Operations: Types of lathes – light duty, Medium duty and heavy duty geared lathe, CNC lathe (Concept only); Specifications; Basic parts and their functions; Operations and tools–Turning, parting off, Knurling, facing, Boring, drilling, threading, step turning, taper turning.

Unit-II:

(12Hrs)

Broaching Machines: Introduction to broaching; Types of broaching machines–Horizontal type (Single ram & duplex ram), Vertical type, Pull up, pull down, and push down; Elements of broach tool; Nomenclature; Tool materials for broaching.

Drilling: Classification; Basic parts and their functions; Radial drilling machine; Types of operations; Specifications of drilling machine; Types of drills and reamers.

Unit-III:

(14Hrs)

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.

Milling: Introduction; Types of milling machines: plain, Universal, vertical; constructional details – specifications; Milling operations: simple, compound and differential indexing (No Numerical); Milling cutters –types; Teeth materials; Tool signature in ASA; Tool & work holding devices.

Unit-IV:

(14Hrs)

Gear Making: Manufacture of gears–by Casting, Moulding, Stamping, Coining, Extruding, Rolling, Machining; Gear generating methods: Gear Shaping with pinion cutter & rack cutter; Gear hobbing; Description of gear hob; Operation of gear hobbing machine; Gear finishing processes; Gear materials and specification; Heat treatment processes applied to gears.

Press working (derivations and problems omitted): Types of presses and Specifications, Press working operations–Cutting, bending, drawing, punching, blanking, notching, lancing; Die set components- punch and dieshoe, guide pin, bolster plate, stripper, stock guide, feed stock, pilot; Punch and die clearances for blanking and piercing, effect of clearance.

Unit-V:

(12Hrs)

Grinding and finishing processes: Principles of metal removal by Grinding; Abrasives –Natural & Artificial; Bonds and binding processes: Vitriified, silicate, shellac, rubber, bakelite; Factors affecting the selection of grind wheels: size and shape of wheel, kind of abrasive, grain size, grade and strength of bond, structure of grain, spacing, kinds of bind material; Grinding machines classification: Cylindrical, Surface, Tool & Cutter grinding machines; Construction details; Principle of centerless grinding; Advantages & limitations of centerless grinding; Finishing by grinding: Honing, Lapping, Super finishing; Electroplating: Basic principles,

Plating metals, applications; Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing; Metal spraying: wire process, powder process and applications; Organic coatings;;Finishing specifications.

Reference Books:

1. Manufacturing technology–P N Rao, Tata Mc Graw -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, TataMcGraw-Hill Publications
6. Production Technology–R .B. Gupta, Satya Prakashan, New Delhi

Course outcomes:

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

C01	Know and identify basic manufacturing processes for manufacturing different components.
C02	Operate & control different machines and equipment.
C03	Produce jobs as per specified dimensions and inspect the job for specified dimensions.
C04	Select the specific manufacturing process for getting the desired type of output.
C05	Adopt safety practices while working on various machines.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	12	12
3	14	12
4	14	12
5	12	12
Total	64	60

*Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechatronics.

Course Code	:	MEPC209
Course Title	:	THERMAL ENGINEERING-I
Number of Credits	:	3 (L:3, DCS:1, P:0)
Pre requisites	:	Basic Mechanical Engineering
Course Category	:	PC

Course Objectives:

- To give a good understanding of and thorough insight into all important aspects of thermal systems, energy control and the general issue of energy.
- To understand the principles & working of various power producing & power absorbing devices.
- To study, analyze and evaluate the operation and the performance of I.C. engines, compressors and refrigerators, to apply pinch technology and to critically analyze and describe the global behavior of integrated thermal systems.

Course Content:

UNIT-I:

(12Hrs)

Sources of Energy: Brief description of energy Sources: Classification of energy sources:

Renewable, Non-Renewable; Solar Energy: Flat plate and concentrating collectors & its applications (Solar Water Heater, Photovoltaic Cell); Wind Energy; Tidal Energy; Ocean Thermal Energy; Geothermal Energy; Biogas, Biomass, Bio-diesel; Hydraulic Energy.

Unit-II:

(12Hrs)

Internal Combustion Engines: Assumptions made in air standard cycle analysis; Brief description along with derivation of efficiency of Carnot, Otto and Diesel cycles with P-V and T-S diagrams; Internal and external combustion engines; classification of I.C. engines; Function of each part and materials used for the component parts - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cylinder heads, exhaust valve, inlet valve; Working of four-stroke and two-stroke petrol and diesel engines; Comparison of two stroke and four stroke engines; Comparison of C.I. and S.I. engines; Valve timing and port timing diagrams for four stroke and two stroke engines.

Unit III:

(12Hrs)

I.C. Engine Systems: Fuel system of Petrol engines; Principle of operation of simple carburetor; Fuel system of Diesel engines; Plunger type fuel injection pump, fuel feed pump and fuel injector (description with line diagram); Cooling system ; Air cooling, water cooling system with thermosiphon method of circulation and water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system; Ignition systems–Battery coil ignition and magneto ignition (description and working). Comparison of two systems; Types of lubricating systems used in I.C. engines with line diagram; Objective of turbocharging and supercharging.

Unit-IV:

(12Hrs)

Performance of I.C. Engines: Brake power; Indicated power; Frictional power; Brake and Indicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency; Relative efficiency; Performance test; Morse test; Heat balance sheet; Methods of determination of B.P., I.P. and F.P.; Simple numerical problems on performance of I.C. engines.

Unit-V:

(16Hrs)

Air Compressors: Functions of air compressor; Uses of compressed air; Types of air compressors; Single stage reciprocating air compressor - its construction and working (with line diagram); Multistage compressors–Advantages over single stage compressors; Description of Rotary compressors, Centrifugal compressor, axial flow type compressor and vane type compressors.

Refrigeration & Air-conditioning (Problems omitted): Refrigeration; Refrigerant; COP; Air Refrigeration system: components, working & applications; Vapour Compression system: components, working & applications; Air conditioning; Classification of Air-conditioning systems; Window Air-Conditioner; Summer Air-Conditioning system, Winter Air-Conditioning system, Year-round Air-Conditioning system, Central air conditioning system.

Reference Books:

1. Introduction to Renewable Energy–Vaughn Nelson, CRC Press
2. Thermal Engineering– P.L. Ballaney, Khanna Publishers,2002
3. A Course in Thermal Engineering–S. Domkundwar & C.P .Kothandaraman,Dhanpat Rai.
4. Thermal Engineering– R.S.Khurmi and J.K.Gupta, 18th Edition, S.Chand & Co,New Delhi.
5. Thermal Engineering–R.K.Rajput, 8th Edition, Laxmi publications Pvt Ltd,NewDelhi.

Course out comes:

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

C01	Know various sources of Energy and their applications.
C02	Classify I.C .engines and understand their working and constructional features.
C03	Draw the energy flow diagram of an I.C. engine and evaluate its performance.
C04	Describe the constructional features of air compressor
C05	Know the applications of refrigeration and Classify air-conditioning systems.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	12	12
3	12	12
4	12	12
5	16	14
Total	64	60

Course Code	:	MEPC211
Course Title	:	MANUFACTURING ENGINEERING LAB-I
Number of Credits	:	2 (L:0, DCS: 2, P:4)
Prerequisites	:	Basic Mechanical Engineering, Manufacturing Engineering
Course Category	:	PC

Course Objectives:

- To know the working and practice different operations of Lathe.
- To know the working of Drilling machine, shaper, slotter, planning machines and practice different operations on these machines.
- To know various pattern allowances, pattern materials, different types of patterns.
- To Practice the casting principles and operations in foundry.

LIST OF PRACTICALS

Note:- Demonstration of all machines should be given before starting the practical. The instructor should explain parts of machine, work & tool holding devices, different types of cutting tools and safety measures.

1. Job on facing and turning.
2. Job on step tuning and grooving on job number 1.
3. Job on taper turning and chamfering, knurling on job number 1.
4. Job on internal turning and threading on job number 1.
5. Job on marking and drilling practice on mild steel round pieces.
6. Job on Boring and reaming on job number 5.
7. Drilling Exercise(Three different sized hole for different materials maintaining uniform distance between them)
8. Shaping a Hexagon on a round bar, key ways and groove.
9. Shaping step block cut dovetail to angles 60/90/120 degrees
10. Moulding & casting of (i) Solid bearing (ii) V-Pulley/ Gear Pulley by preparing suitable pattern.
11. Simple planning exercise .
12. Grinding the Lathe Cutting tools to the required angles
13. Study of Lathe, Drilling machine, shaping machine and slotting machine
14. The dismantling of some of the components of lathe and then assemble the same
15. List the faults associated with lathe and its remedies
16. The routine and preventive maintenance procedure for lathe

Reference Books:

1. Elements of Workshop Technology (Volume-I & Volume-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, 5th edition, Tata McGraw Hill, New Delhi.

Course Outcomes:

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

CO1	Centre the job and select the proper tool to perform the job on lathe machine.
CO2	Calculate the taper angle and practice different taper turning methods on lathe.
CO3	Perform operations on drilling, shaping and planning machines.
CO4	Prepare different types of patterns along with allowances.
CO5	Prepare a mould, sand mix and molten metal and calculate the amount of metal to be Poured in the mould.

Course Code	:	MEPC213
Course Title	:	MEASUREMENTS & METROLOGY LAB
Number of Credits	:	1(L:0,P:2)
Prerequisites	:	Measurements & Metrology
Course Category	:	PC

Course Objectives:

- To understand techniques for precise measurement of the dimensions of various objects and shapes.

Course Content:

S.No.	Topics for practice
I	Measure the diameter of a wire using micrometer and compare the result with digital micrometer
II	Measure the angle of the machined surface using sine bar with slip gauges.
III	Measure the angle of a V-block/Taper Shank of Drill/Dove tail using universal bevel protractor.
IV	Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.
V	Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
VI	Measure the thickness of ground MS plates using slip gauges
VII	Measure the surface roughness using roughness tester.
VIII	Measurement of geometrical parameters of components like screw, gear etc. using Toolmakers microscope/ profile projector.

Reference Books:

- Engineering Metrology–R.K. Jain
- Engineering precision metrology–R.C. Gupta
- A Handbook of Industrial Metrology–ASME

Course outcomes:

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

C01	Measure various component of linear measurement using Vernier calipers and Micrometer.
C02	Measure various component of angle measurement using sine bar and bevel Protractor
C03	Measure the geometrical dimensions of V-thread and spur gear

Course Code	:	MEPC215
Course Title	:	Thermal Engineering Lab-I
Number of Credits	:	1(L:0 ; P:2)
Pre requisites	:	Thermal Engineering-I
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 function of Ignition, cooling and lubrication system of I.C. engine.
- 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 and 4-Stroke engines.

Course Content:

S.No.	Topics for practice
I	Flash & Fire point tests using Able's/Cleveland/Pensky Martin Apparatus
II	Calorific value tests using bomb Calorimeter (Solid and liquid fuels).
III	Assembling and disassembling of I.C. Engines
IV	Study of Port timing diagram of I.C engine(Petrol/ Diesel)
V	Study of Valve timing diagram of I.C engine(Petrol/ Diesel)
VI	Study of petrol and diesel engine components and Models
VII	Study of MPFI system. .
VIII	Study of Battery ignition system of multi cylinder petrol engine.
IX	Study of Cooling system of I.C. engine.
X	Study of Lubrication system of I.C. engine.

Reference Books:

1. Thermal Engineering–P.L.Ballaney, Khanna Publishers, 2002
2. A Course in Thermal Engineering–S. Dom kundwar & 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 outcomes:

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

C01	Understand the determination of flash and fire point of a given sample of fuel using given Apparatus (Abels, Cleve and & Penesky martin)
C02	Understand the determination of Viscosity of a given sample of oil using given apparatus.
C03	Draw VTD/PTD of given I.C. Engine and understand how the processes are controlled during its operation.
C04	Understand the function of ignition system of petrol engines..
C05	Understand the function of Cooling and Lubrication system of I.C. Engine.
C06	Understand the functions of various parts of IC engines and the working of IC engines.

SEMESTER IV

Course Code	:	MEPC202
Course Title	:	STRENGTH OF MATERIALS
Number of Credits	:	3 (L:3, DCS:1, P:0)
Pre requisites	:	Engineering Mechanics
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 Content:

UNIT-I:

(14Hrs)

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 M.S. and C.I. specimens; Significance of factor of safety; Relation between elastic constants (Formula without proof); Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in body of uniform section; Simple numerical problems on the above topics.
Strain Energy: Strain energy or resilience, proof resilience and modulus of resilience; Formula without derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load; Simple numerical problems.

Unit-II:

(14Hrs)

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 simple numerical problems.

Unit- III:

(12Hrs)

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 $M/I = \sigma/Y = E/R$; Simple Problems involving calculations of bending stress, modulus of section and moment of resistance; 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 simple numerical problems.

Unit-IV:

(14Hrs)

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 $T/J = f_s/R = G\theta/L$; Simple 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; Simple Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

Unit-V:**(10Hrs)**

Thin Cylindrical Shells: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Derivation of expressions for the longitudinal and hoop stress; Related numerical Problems.

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

Course outcomes:

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

C01	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.
C02	Calculate thermal stresses, in bodies of uniform section and composite sections.
C03	Define resilience, proof–resilience and modulus of resilience and obtain expressions for Instantaneous stress developed in bodies subjected to different loads.
C04	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.
C05	Calculate the safe load, safe span and dimensions of cross section.
C06	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.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	12
2	14	12
3	12	12
4	14	12
5	10	12
Total	64	60

*Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechanical Engineering (Tool & Die).

Course Code	:	MEPC204
Course Title	:	THERMAL ENGINEERING-II
Number of Credits	:	3 (L:3, DCS:1, P:0)
Pre requisites	:	Thermal Engineering-I
Course Category	:	PC

Course Objectives:

- To understand the working and applications of Gas turbines & Jet Propulsion.
- To understand the methods of computing various properties of steam.
- To understand the working of various Steam Boilers, functions of various accessories and mountings of boilers.
- To understand the Working of Steam Nozzles and Steam turbines.
- To understand the necessity of compounding and governing of a turbine.

Course Content:

UNIT-I:

(14Hrs)

Gas Turbines (Problems omitted): Air-standard Brayton cycle; Brief description along with derivation of efficiency of Air standard Brayton Cycle with P- V and T-S diagrams, Gas turbines Classification: open cycle gas turbines and closed cycle gas turbines; comparison of gas turbine with reciprocating I.C. engines and steam turbines. Applications and limitations of gas turbines; General layout of Open cycle constant pressure gas turbine; P-V and T-S diagrams and working; General layout of Closed cycle gas turbine; P-V and T-S diagrams and working.

Jet Propulsion (derivations and Problems omitted): Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbo jet engine; Principle of Ram effect; Working of a Ramjet engine; Principle of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.

Unit-II:

(12Hrs)

Properties of Steam: Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid line, saturated vapour line, liquid region, vapour region, wet region, super heat region, critical point, saturated liquid, saturated vapour, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, wetness fraction, saturated steam, superheated steam, degree of superheat; Determination of enthalpy, volume and entropy of wet, dry and super heated steam using steam tables and Mollier chart, Throttling process, Simple direct problems on the above using steam tables and Mollier charts.

Unit-III:

(14Hrs)

Steam Generators: Function and use of steam boilers; Classification of steam boilers with examples; Brief explanation with line sketches of Cochran, Babcock and Wilcox Boilers; Comparison of water tube and fire tube boilers; Description with line sketches and working of modern high pressure boilers Lamont and Benson boilers; Boiler mountings: Pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valve, (dead weight type, spring loaded type); Boiler accessories: economizer, super heater and air pre-heater; Study of steam traps & separators; Concept of the terms: Actual evaporation, equivalent evaporation, factor of evaporation, boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems on the above terms.

Unit-IV:

(12Hrs)

Steam Nozzles : Type of steam nozzles; Flow of steam through nozzle; Velocity of steam at the exit of nozzle in terms of heat drop using analytical method; Simple direct problems on the above only using analytical method, Discharge of steam through nozzles; Critical pressure ratio; Methods of calculation of cross-sectional areas at throat and exit for maximum discharge.

Unit-V:**(12Hrs)**

Steam Turbines (Problems omitted): Classification of steam turbines with examples; Difference between impulse & reaction turbines; Principle of working of a simple De-lavel turbine with line diagrams- Velocity diagrams (Diagrammatic representation only); Methods of reducing rotor speed; compounding for velocity, for pressure or both pressure and velocity; Working principle with line diagram of a Parson's Reaction turbine-velocity diagrams(Diagrammatic representation only);Bleeding, re-heating and re-heating factors; Governing of steam turbines: Throttle, By-pass & Nozzle control governing.

Reference Books:

- 1.A Course in Thermal Engineering–S. Domkundwar & C.P.Kothandaraman, Dhanpat Rai & Publication, New Delhi
2. Thermal Engineering–R.K. Rajput, Laxmi Publication NewDelhi
3. Thermal Engineering–P.L.Ballaney,Khanna Publishers,2002
4. Heat Engineering in MKS and SI Units–V.P.Vasandani &D.S. Kumar, Metropolitan Book Co. Pvt. Ltd,NewDelhi.

Course outcomes:

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

C01	Explain the working cycle of gas turbines, and the working of Jet and Rocket Engines apart From identifying the fuels used for Jet and Rocket propulsion.
C02	Compute the work done, enthalpy, internal energy and entropy of steam at given conditions using steam tables and Mollier chart.
C03	Distinguish between water tube and fire-tube boilers and explain the function of all the Mountings and accessories.
C04	Calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by Using Mollier chart.
C05	State the necessity of governing and compounding of a turbine.
C06	Explain the principle of working of a steam turbine and distinguish between the impulse Turbines and reaction turbines.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	12
2	12	12
3	14	12
4	12	12
5	12	12
Total	64	60

Course Code	:	MEPC206
Course Title	:	MATERIAL TESTING LAB
Number of Credits	:	1(L:0,DCS:0,P:2)
Pre requisites	:	Material Science & Engineering, Strength of Materials
Course Category	:	PC

Course Objectives:

- To identify the type of material based on its grain structure
- To learn the procedure for identifying the cracks in the material
- To understand various material testing methods to determine mechanical properties such as yield stress, Ultimate stress, percentage elongation, Young's Modulus etc.

Course Content:

S. No.	Topics for practice
I	Prepare a specimen and examine the microstructure of the Ferrous and Non-ferrous metals using the Metallurgical Microscope.
II	Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.
III	Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum.
IV	Finding the resistance of materials to impact loads by Izod test and Charpy test.
V	Torsion test on mild steel–relation between torque and angle of twist determination of shear modulus and shear stress.
VI	Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
VII	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
VIII	Single or double Shear test on M.S. bar to finding the resistance of material to shear load.

Reference Books:

1. Measurement system (Application and Design)–Ernest O Doebelin.
2. Strength of Materials–R.S. Khurmi, S.Chand Company Ltd. Delhi
3. A Text Book strength of Material–R.K.Bansal, Laxmi Publication New Delhi

Course outcomes

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

CO1	Identify the given specimen by viewing the microstructure using metallurgical microscope
CO2	Identify the cracks in the specimen using different techniques
CO3	Determine the various types of stress and plot the stress strain diagram for mild steel.
CO4	Determine the torsion, bending, impact and shear values of given materials
CO5	Determine the modulus of rigidity, strain energy, shear stress and stiffness of coil spring

Course Code	:	MEPC208
Course Title	:	COMPUTER AIDED MACHINE DRAWING PRACTICE
Number of Credits	:	2(L:0,DCS:0,P:4)
Prerequisites	:	Engineering Graphics
Course Category	:	PC

Course Objectives:

- To use computer aided drafting,
- To prepare geometrical model of various machine elements
- To draw the different views of machine elements
- To interpret the drawing in engineering field and illustrate three dimensional objects

Course Content:

S.No.	Topics for practice
I	Introduction to CAD software.
II	Drawing aids and editing commands.
III	Basic dimensioning, hatching, blocks and views.
IV	Isometric drawing, printing and plotting
V	Machine Drawing practice using Auto CAD: Detailed drawings of following machine parts are to be given to the students to assemble and draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using cad software (any 10 exercises). 1) Sleeve & Cotter Joint 2) Spigot & Cotter Joint 3)Knuckle Joint 4) Stuffing Box 5)ScrewJack 6) Foot Step Bearing 7) Universal Coupling 8) Plummer Block 9)Simple Eccentric 10) Machine Vice 11)Connecting Rod 12) Protected Type Flanged Coupling.

Reference Books:

1. Bhatt , N.D.,Machine Drawing, Charotar Publishing House,2003.
2. Sidheswar, N.,Kannaiah, P.and Sastry,V.V.S., Machine Drawing, Tata McGraw Hill Book Com-pany, New Delhi
3. Kannaih, P.,Production Drawing, New Age International,2009

Course outcomes:

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

C01	Understand the representation of materials used in machine drawing
C02	Draw the development of surfaces for sheet metal working applications.
C03	Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.
C04	Construct an assembly drawing using part drawings of machine components
C05	Represent tolerances and the levels of surface finish of machine elements.

Course Code	:	MEPC210
Course Title	:	THERMAL ENGINEERING LAB-II
Number of Credits	:	1(L:0,P:2)
Prerequisites	:	Thermal Engineering – I, Thermal Engineering-II
Course Category	:	PC

Course Objectives:

- To understand the working of boilers, compressors and IC engines.
- To observe various parts of engines and understand their functions.
- To perform various tests on IC engines and calculate performance parameters.
- To perform various tests on refrigerating units.

Course Content:

S.No.	Topics for practice
I	Study of Cochran, Babcock and Wilcox boiler with model
II	Study of boiler mountings and accessories
III	Conduct performance test on VCR test rig to determine COP of the refrigerator
IV	Conduct performance test on reciprocating compressor
V	Conduct Morse test to determine the indicated power of individual cylinders
VI	Conduct Performance test on 2/4-Stroke CI/SI engine.
VII	Conduct Heat balance test on CI/SI engine..
VIII	Study of steam turbine through models..
IX	Thermal conductivity test on Thick slab/Thick cylinder
X	Leak detection of refrigeration equipment

Reference Books:

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

Course outcomes

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

C01	Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.
C02	Find the indicated power of individual cylinders of an engine by using morse test.
C03	Evaluate the performance characteristics of air compressor
C04	Evaluate the coefficient of performance of refrigerator
C05	Find the thermal conductivity of material

Course Code	:	MEPC212
Course Title	:	MANUFACTURING ENGINEERING LAB-II
Number of Credits	:	2 (L:0, P:4)
Prerequisites	:	Basic Mechanical Engineering, Manufacturing Engineering-I
Course Category	:	PC

Course Objectives:

- To practice the joining of metals using different Welding techniques.
- To practice more operations on lathe Machine
- To prepare job from pattern and further by casting
- To prepare job by forging.
- To practice different metal finishing Processes.

LIST OF PRACTICALS

Note-: Demonstration of all machines should be given before starting the practical. The Instructor should explain parts of machine, work & tool holding devices, different types of cutting tools and safety measures.

1. Arc welding (i) Lap Joint (ii) Butt Joint (iii) T-Joint
2. Gas welding (i) Lap joint (ii) Butt Joint
3. Spot welding (i) Lap Joint
4. To prepare a gear blank on lathe machine.
5. Cylindrical grinding on lathe with tool post grinding attachment.
6. Moulding & casting of Connecting rod by preparing suitable pattern.
7. Preparation of a single ended spanner by hand forging.
8. Mounting and balancing of grinding wheel.
9. Cylindrical grinding of external surface and internal surface using universal grinding machines
10. Practice on centreless grinding machine.
11. Grinding flat surface on a surface grinder using magnetic table and clamping devices
12. Practice on cylindrical and centreless grinding machines.
13. Grinding Cutting tools to the required angles
14. Dismantling some of the components of drilling machine and service, assemble the same
15. Dismantling some of the components of shaper head and then assemble the same
16. Servicing of universal grinding machine

Reference Books:

1. Elements of Workshop Technology (Volume-I & Volume-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, 5th edition, Tata McGraw Hill, New Delhi.

Course Outcomes:

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

CO1	Prepare the edges for welding and select the suitable electrode, voltage and current.
CO2	Operate the welding transformer and generator to perform various weld joint operations.
CO3	Prepare a job from pattern and casting practices.
CO4	Perform different operations of metal finishing on related machines.

Course Code	:	PR-202
Course Title	:	MINOR PROJECT
Number of Credits	:	2 (L:0, DCS:0, P:4)
Prerequisites	:	NIL
Course Category	:	PR

Course Objective:

- To provide the students with an opportunity to showcase their ability to develop a complete project by applying the principles of Mechanical Engineering and the experience gained during Industrial training.
- To synthesize and apply the knowledge gained over the engineering program to solve real world problems.

Guidance for Minor Project:

This is to be done during 4th Semester. It will be evaluated as part of Semester IV. It may either be a complete project related to field of Mechanical Engineering or other relevant fields.

Course Content:

1. Identification of a real life problem in thrust areas.
2. Developing a model for solving the problem.
3. Finalization of requirements.
4. Proposing different solutions for the problems based on survey.
5. Future trends in providing alternate solutions.
6. Consolidated report preparation of the above.

Course Outcome(s):

At the Completion of this course, the student will be able to:

C01	Fulfill team roles assigned.
C02	Communicate effectively.
C03	Solve engineering problems involving current issues using modern tools.
C04	Demonstrate the ability to apply the knowledge gained in the program.
C05	Prepare project report

Criteria for Minor Project Evaluation (Internal Assessment)

Sr. No.	Criteria for Project Evaluation	Weightage
1	Synopsis and Project Title Selection	10%
2	Initiative in performing tasks during project work	30%
3	Report Writing	15%
4	Attendance and punctuality	10%
5	Final outcome as per objectives set by student(s)	20%
6	Viva	15%

Criteria for Minor Project Evaluation (External Assessment)

Sr. No.	Criteria for Project Evaluation	Weightage
1	Seminar through Power Point Presentation	50 %
2	Report	20%
3	Viva	30%

Appendix-I

PROGRAMME ELECTIVE COURSES

Course Code	:	MEPE202-1
Course Title	:	TOOL ENGINEERING
Number of Credits	:	3 (L:3, P:0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

- To understand metal cutting and forming process and factors affecting machinability.
- To develop knowledge of tools, dies and tool materials.
- To understand processes for increased productivity and quality.

Course Content:

UNIT-I

(12Hrs)

Metal Cutting: Mechanics of Metal cutting; requirements of tools; cutting forces; types of chips; chip thickness ratio; shear angle ; simple numericals only; types of metal cutting process; orthogonal; oblique cutting

Cutting fluids: types ; characteristics and applications.

Tool wear: Types of wear; Tool life; Tool life equations.

Unit-II:

(08Hrs)

Machinability: definition; factors affecting machinability; machinability index.

Tool materials: Types; characteristics; applications; Heat treatment of tool steels; Types of ceramic coatings.

Cutting Tool Geometry: Single point cutting tool; drills ;reamers; milling; cutters.

Unit-III:

(08Hrs)

Types of dies and construction: Simple Die; Compound Die; Progressive Die; Combination Die.

Punch & Die mountings : pilots; strippers ;miss feed detectors; Pressure Pads; Knockouts; stockguide; Feed-Stop; guide bush; guide pins.

Unit-IV:

(08Hrs)

Die Design Fundamentals: Die Operations; blanking; piercing; shearing; trimming; notching;

lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; clearances on die and punch for blanking and piercing dies; Strip layout; Calculation of material utilization factor.

Unit- V:

(12Hrs)

Forming Dies :Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length (Concept only).

Drawing: operations; Metal flow during drawing; Calculation of Drawing blank size; variables affecting metal flow during drawing; single action and double action dies; combination dies.

Fundamentals of other Tools: Constructional features of-Pressure Die casting dies; metal extrusion dies; injection molding dies; forging dies; plastic extrusion dies.

Reference Books:

1. Tool Design- Donaldson Anglin, Tata McGraw Hill.
2. Production Technology-H.M.T.Jain ,Tata McGraw Hill.
3. A Text Book of Production engineering–P.C. Sharma, S.Chand &Co.
4. Production Technology, R.K. Jain, Khanna Publishers.

Course outcomes:

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

C01	Understand concepts, principles and procedures of tool engineering
C02	Classify and explain various tools and tool operations
C03	Select proper tool and a die for a given manufacturing operation to achieve highest productivity
C04	Estimate tool wear and tool life

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	08	12
3	08	12
4	08	12
5	12	12
Total	48	60

*Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning), Mechanical Engineering (Tool & Die).

Course Code	:	MEPE202-2
Course Title	:	INDUSTRIAL ROBOTICS & AUTOMATION
Number of Credits	:	3 (L: 3, P:0)
Prerequisites (Course code)	:	NIL
Course Category	:	PE

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
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.
- To conceptualize automation and understand applications of robots in various industries.

Course Content:

UNIT-I:

(12Hrs)

Fundamentals of Robotics: Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, Scara, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Robot work Volumes, comparison; Advantages and disadvantages of robots.

Unit-II:

(10Hrs)

Robotic Drive System and Controller: Actuators; 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; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Robot path control: Point to point, Continuous path control and Sensor based path control;

Unit-III:

(12Hrs)

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); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification,

Unit-IV:

(08Hrs)

Robot kinematics and Robot Programming: Forward Kinematics; Inverse Kinematics; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional);(Deviations and Problems omitted). Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effector commands.

Unit-V:

(06Hrs)

Automation: Basic elements of automated system, advanced automation functions, levels of automation. **Industrial Applications:** Application of robots in machining; welding; assembly and material handling. applications in robots and programming of robots.

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 Mc GrawHill Co, 2001.
3. Robotics Control, Sensing, Vision and Intelligence–Fu.K.S. Gonzalz. R.Cand Lee C.S.G,Mc-GrawHill Book Co, 1987.
4. Robotics for Engineers–Yoram Koren, McGraw Hill Book Co, 1992.
5. A Textbook on Industrial Robotics–Ganesh S. Hedge,Laxmi Publications Pvt. Ltd., NewDel-hi,2008.
6. Robotics Technology and Flexible Automation–S.R.Deb& SankhaDeb,Tata McGraw-Hill,2010.
7. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House ,Delhi,2018

Course outcomes:

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

C01	Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.
C02	Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
C03	Explain about various types of sensors and concepts on robot vision system.
C04	Explain the concepts of robot programming languages and various methods of robot programming.
C05	Explain the various applications of robots.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	14
2	10	12
3	12	14
4	08	12
5	06	08
Total	48	60

* Common with diploma in Mechanical Engineering (Tool & Die).

Course Code	:	MEPE202-3
Course Title	:	AUTOMOBILE ENGINEERING
Number of Credits	:	3 (L:3, DCS:0,P:0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

Course Content:

UNIT-I:

(08Hrs)

Introduction to basic structure of an automobile: Basic engine components; Cylinder block; Cylinder head; Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin; piston rings, types of piston rings; Connecting rod; Crank shaft; Cam shaft; Crankcase; Engine valves; Fly- wheel and Governor.

Unit-II:

(12Hrs)

Cooling and lubrication system: The necessity of cooling system; Types of cooling system-air cooling and water cooling; Air cooling system; Types of water cooling system – Thermosyphon system and pump circulation system; Advantages and disadvantages of air cooling and water cooling systems; The components of water cooling system–fan, radiator, pump and thermostat; The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system.

Fuel feed system: Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburetors; Working of simple carburetor; Multi point and single point fuel injection systems; Different fuel transfer pumps; Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors; Use of Hydrogen and Ethanol as an alternating fuel (Basic concept only).

Unit-III:

(12Hrs)

Ignition system: Introduction to ignition system; Battery Ignition systems and magneto Ignition system; Electronic Ignition system; Construction and working of lead acid battery; Elements of charging system; Elements of starting system; Types of lights used in the automobile:

Transmission and steering system: General arrangement of clutch; Principle of friction clutches; Constructional details of Single plate clutch; Constructional details of multi-plate clutch; Constructional details of centrifugal clutch; Necessity for gear ratios in transmission; Types of gear boxes; Working of sliding mesh gear box; Working of constant mesh gear box; Working of propeller shaft Working of propeller shaft; Working of universal joint; Working of differential; Types of rear axle; Purpose of front axle; Necessity of steering system; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.

Unit-IV:

(10Hrs)

Suspension system: Necessity of suspension system; Torsion bar suspension systems; Leaf spring and coil spring suspension system; Independent suspension for front wheel and rear wheel; Working of telescopic shock absorber; Functions of brakes; Types of brakes; Working of internal expanding brake; Working of disc brake

Unit-V:**(06Hrs)**

Special vehicles: Introduction to Special vehicles; Tractor; Motor grader; Scrappers; Excavators; Duper trucks.

Hybrid and Electric Vehicles: Introduction to Hybrid and Electric Vehicles; History of Hybrid and Electric Vehicles; Social and environmental importance of Hybrid and Electric vehicles; Electric Vehicle drive train (line diagram only).

Reference Books:

1. Automobile Engineering VolI,II, Kirpal Singh, Standard Publishers Distributors, Delhi.2012.
2. Automobile Mechanics ,A.K.Babu, S.C.Sharma, Khanna Publications, New Delhi
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
4. Automotive Mechanics, S.Srinivasan,2nd Edition, Tata McGraw Hill
5. Automobile Engineering VolI and VolII, K.M.Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

Course outcomes

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

C01	Identify the components of an automobile with their working
C02	Explain the concepts of cooling and lubricating systems.
C03	Explain the concepts of Ignition and Transmission and steering systems.
C04	Identify different suspension systems and their applications.
C05	Differentiate the special vehicles according to the usage.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	08	10
2	12	14
3	12	14
4	10	12
5	06	10
Total	48	60

* Common with diploma in Mechanical Engineering (Tool & Die).

Course Code	:	MEPE204-1
Course Title	:	POWER PLANT ENGINEERING
Number of Credits	:	3 (L:3, P:0)
Prerequisites	:	Thermal Engineering-I
Course Category	:	PE

Course Objectives:

- To understand the present scenario of power in India.
- To recognize various load terminologies used in power plants.
- To understand hydro working principles
- To understand working of Diesel, Gas and Nuclear power plants.
- To understand the issues and safety precautions in power plants.

Course Content:

UNIT-I: (08Hrs)

Introduction to Power plant: Introduction to power plant; Indian Energy scenario in India; Location of power plant; Choice of Power plant; Classification of power plants.

Unit-II: (08Hrs)

Economics of power plant: Terminology used in power plant: Peak load, Base load factor (Introduction only); Various factor affecting the operation of power plant; Methods of meeting the fluctuating load in power plant; Performance and operating characteristics of power plant.(Theoretical concept only)

Unit-III: (12Hrs)

Hydro power plant: Introduction to Hydro electric power plant; Rainfall, Runoff and its measurement, Hydrograph, flow duration curve; Selection of sites for hydro electric power plant; General layout of Hydro electric power plant and its working; Classification of the Plant- Run off river plant, storage river plant, pumped storage plant; Advantages and disadvantages of hydro electric power plant.

Unit-IV: (12Hrs)

Diesel and Gas turbine plant: The layout of diesel power plant; Components and the working of diesel power plant; Advantages and disadvantages of diesel power plant; Gas turbine power Plant- Schematic diagram, components and its working; Combined cycle power generation- Combined gas and steam turbine power plant operation (only flow diagram).

Nuclear power plant: Introduction; Nuclear Power-Radio activity-Radioactive charge-types of reactions; Working of a nuclear power plant; Thermal fission Reactors- PWR, BWR and gas cooled reactors; Advantages and Disadvantages of Nuclear power plant.

Unit-V: (08Hrs)

Environmental impact of Power plant: Social and Economical issues of power plant; Green house effect; Acid precipitation-Acid rain, Acid snow, Dry deposition, Acid fog; Air, water, Thermal pollution from power plants; Radiations from nuclear power plant effluents.

Power plant safety: Plant safety concept; Safety policy to be observed in power plants; Safety practices to be observed in boiler operation; Safety in oil handling system; Safety in Chemical handling system; Statutory provision related to boiler operation.

Reference Books:

1. Power plant Engineering-P.K. Nag 4th edition,Tata McGraw Hill Education,2014.
2. Power plant Engineering– Frederick T.Morse, Litton Educational Publishing Inc.1953.
3. A Course in Power Plant Engineering–Subhash C. Arora, S. Domakundwar, Dhanpat Rai,1984.
4. Power Plant Engineering–P.C. Sharma, S.K. Kataria & sons,2009.
5. Power System Engineering–R.K. Rajput, Firewell Media,2006.

Course outcomes

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

C01	Familiarized with the present and future power scenario of India.
C02	Enlist various load terminologies in power plants
C03	Working and classifications in hydro power plant
C04	Working principles of Diesel, Gas and Nuclear power plants.
C05	Understand the issues and necessity of safety concepts of power plants.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	08	10
2	08	10
3	12	15
4	12	15
5	08	10
Total	48	60

* Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning)

Course Code	:	MEPE204-2
Course Title	:	PRODUCTION & OPERATIONS MANAGEMENT
Number of Credits	:	3 (L:3,P:0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

One of the most critical areas for success in any business enterprise is how Production and Operations are managed.

- To study the statistics, economics, finance, organizational behavior and strategy into a consolidated production and operation related decisions.
- To discuss the role of location strategy and the criteria for location decisions.
- To define quality and explain quality management, including TQM and its tools.

Course Content:

UNIT-I:

(14Hrs)

Process Planning and Process Engineering: Process Planning: Introduction, Function, Pre-requisites and steps in process planning, Factors affecting process planning, Make or buy decision, plant capacity and machine capacity. Process Engineering: Preliminary Part Print Analysis: Introduction, General Characteristics of work piece, determining the principal Process, Functional surfaces of the workpiece, Nature of the work to be Performed, Finishing and identifying operations. Dimensional Analysis: Introduction, types of dimensions, measuring the Geometry, Baselines, Direction of specific dimensions. Tolerance Analysis: Causes of work piece variation, Terms used in workpiece dimensions. Workpiece Control: Introduction, Concept of location, Geometric Control, Dimensional control, Mechanical control.

UNIT-II:

(10Hrs)

Production Forecasting: Introduction of production forecasting, The strategic role of forecasting in supply chain, Time frame, Demand behavior, Forecasting methods- Qualitative and Quantitative, Forecast accuracy.

Scheduling:

Introduction, Objectives in scheduling, Loading, Sequencing, Monitoring, Advanced Planning and Scheduling Systems, Theory of Constraints, Employee scheduling.

UNIT-III:

(10Hrs)

Break-Even Analysis: Introduction, Break-even analysis charts, Breakeven analysis for process, plant and equipment selection.

Aggregate Operations Planning: Aggregate production planning, Adjusting capacity to meet the demand, Demand management, Hierarchical and collaborative planning, Aggregate planning for services.

UNIT-IV:

(08Hrs)

Assembly Line Balancing: Assembly lines, Assembly line balancing, Splitting tasks, Flexible and U-shaped line layouts, Mixed model line balancing, Current thoughts on assembly lines, Computerized assembly line balancing.

UNIT-V:

(06Hrs)

Material Management: Introduction, Importance and objectives, Purchasing and Stores: policies and procedures, Vendor development, selection, analysis and rating

Reference Books:

1. Production and Operations Management–K. Aswathappa, K.Shridhara Bhat ,Himalaya Publish-ing House, 2014.
2. Production and Operations Management–Shailendra Kale ,McGraw Hill Educations(India)Pri- vate Limited,2013.
3. Production and Operations Management–R.Paneerselvam,PHI Learning Private Limited, 2013.
4. Operations Management–Joseph Monk, TMH Publishers, NewDelhi,2004.
5. Modern Production/Operations Management–Buffa ElwoodS, John Wiley Publishers Singapore,2002.

Course outcomes:

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

C01	Define operations management and explain its relationship to productivity. And also understand tools and techniques.
C02	Describe the importance of forecasting and explain the effective application of the different Forecasting approaches and methods.
C03	Explain layout strategy and how operations managers determine facility arrangements and size.
C04	Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity.
C05	Understand make-or-buy decisions, and the selection and integration of suppliers. And how much to order and when to order.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	14
2	10	12
3	10	12
4	08	12
5	06	10
Total	48	60

* Common with diploma in Mechanical Engineering (Tool & Die).

Course Code	:	MEPE204-3
Course Title	:	INDUSTRIAL ENGINEERING & MANAGEMENT
Number of Credits	:	3 (L:3 ,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 Content:

UNIT-I

(06Hrs)

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; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Conciliation; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

UNIT-II:

(14Hrs)

Work Study: Productivity; Standard of living; Method of improving Productivity; Objectives; Importance 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; Two handed process chart; Man Machine chart; String diagram and flow diagram.

Work Measurement: Definition; Basic procedure in making a time study; Employees rating factor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Basic concept of production study; Techniques of Work Measurement; Ratio delay study (Concept only); Synthesis from standard data; Pre deter-mined Motion Time System (PMTS).

UNIT-III:

(14Hrs)

Production Planning and Control (Problems omitted): Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Con- trolling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Production and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision.

Quality Control (Problems omitted): Definition; Objectives; Types of Inspection: First piece, Floor and Centralized Inspection; Advantages and Disadvantages; Statistical Quality Control; Types of Measurements; Method of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve); 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:

(08Hrs)

Principles of Management: Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; 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; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems.

Personnel Management (Problems omitted): Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives and Importance; Wages and Salary Administration; Components of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emerson's efficiency plan.

UNIT-V:

(06Hrs)

Financial Management (Problems omitted): Fixed and Working Capital; Resources of Capital; Shares Preference and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Depreciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method.

Material Management: Objectives of good stock control system; ABC analysis of Inventory; Procurement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level- Economic Order Quantity; simple problems; Supply Chain.

Reference Books:

1. Industrial Engineering & Management, S.C. Sharma, Khanna Book Publishing Co.(P)Ltd., Delhi
3. Industrial Engineering and Management ,O.P .Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi-110002.
4. Management ,A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill International Edition 1994.
5. Essentials of Management,4th Edition, Joseph L.Massie, Prentice-Hall of India ,NewDelhi2004.
6. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N.Delhi

Course outcomes:

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

C01	Explain the different types of layout and plant maintenance with safety
C02	List and explain the need of method study and work measurements
C03	Explain the production planning and quality control, and its functions
C04	Understand the basic principles, approaches and functions of management and identify Concepts to specific situations
C05	List and explain the different financial sources and methods of inventory management

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	06	10
2	14	14
3	14	14
4	08	12
5	06	10
Total	48	60

Appendix-II

AUDIT COURSES

Course Code	:	AU202
Course Title	:	Essence of Indian Knowledge & Tradition
Number of Credits (Teaching Load)	:	0 (L: 2, DCS:0; P:0)
Prerequisites	:	-
Course Category	:	AU (Audit Course)

Course Learning Objectives

The objective of this course is to expose the students with the concepts of Indian traditional knowledge and to make them appreciate the importance of the roots of indigenous knowledge system.

Course Outcomes

After completing this course the students will be able to:

CO-1. Identify the concept of Indian Knowledge System (IKS).

CO-2. Understand the need and importance of protecting traditional knowledge.

CO-3. Compare the Indian traditional knowledge and modern science.

CO-4. Understand the use of Yoga in stress management, mental health, mindfulness, healthy eating, weight loss and quality sleep.

CO-5. Aware of the general knowledge of Himachal Pradesh.

Course Content

Unit 1 Indian Knowledge System (IKS):-----25%

- Introduction and Function of Indian Knowledge System(IKS).
- The Basic Structure of Indian Knowledge System(IKS) (only Introduction)
 1. The 4 Vedas, Namly ऋग्वेद (Rigveda) ,यजुर्वेद (Yajurveda),सामवेद (Samaveda) ,अथर्ववेद (Atharvaveda) .
 2. The 4 UpVedas, Namely आयुर्वेद (Ayurveda (health-care)), धनुर्वेद (Dhanurveda (archery)), गंधर्ववेद (Gandharva-veda (dance, music etc.)) and स्थापत्यवेद (Sthapatyaveda (architecture)).
 3. The 6 Vedagangs ,namely Shiksha (शिक्षा), Kalpa (कल्प), Vykarana (व्याकरण), Chhandas छंदस), Nirukta (निरुक्त), and Jyotisha(ज्योतिष).
 4. Itihasa (इतिहास) (Ramayana रामायण and Mahabharata महाभारत) and Purana पुराण (Vishnupurana विष्णुपुराण , Bhagavata Purana (भागवत पुराण) etc.)
 5. Dharmashatraधर्मशास्त्र (Manusmriti मनुस्मृति, Yajnavalkya-smriti याज्ञवल्क्य स्मृति, etc.).
 6. Darshan दर्शन (आस्तिक तथा नास्तिक).
 7. Nyaya न्याय (Logic तर्कशास्त्र and Epistemology ज्ञानमीमांसा).

Unit 2 : Modern Science **20% Marks**

- Modern science: Introduction, Characteristics, importance and Example

- Difference between modern Science and Indian knowledge system
- Role of IKS in modern science

Unit 3 : Traditional knowledge **15% Marks**

- Traditional knowledge: Definition, nature, characteristics, scope and importance
- Indigenous Knowledge (IK): characteristics
- Traditional knowledge vis-a-vis Indigenous knowledge
- Traditional knowledge Vs western knowledge
- The need for protecting traditional knowledge

Unit 4 : Yoga and Holistic Health Care **25% Marks**

- Yoga: Meaning and Importance of Yoga
- Yoga and physical health, Yoga and psychological health, Yoga and intellectual health, Yoga and spiritual health, Yoga and social approach.
- Introduction to Ashtanga Yoga, Yogic Kriyas (Shat Karma)
- Pranayama and its types; Active lifestyle and stress management through Yoga
- Physical Fitness, Health and wellness: Meaning and Importance of Wellness,
- Components of Wellness, Health and physical Fitness;
- Traditional sports & Regional Games for promoting wellness:
- Leadership through Physical Activity and Sports; Introduction to First Aid.

Unit 5 : Himachal Pradesh: A Basic Information **15% Marks**

- History, Culture, Heritage/ Tradition, Customs & Manners,
- Regional Knowledge, Geographical Features, Constitutional History
- Tourism Place & Scope
- Festivals and Fairs

Suggested Text/ Reference Books

1. Cultural Heritage of India-Course Material by V. SivaramakrishnaBharatiya, VidyaBhavan, Mumbai, 5th Edition, 2014
2. Modern Physics and Vedant by Swami JitatmanandBharatiya, VidyaBhavan
3. The wave of Life by Fritz of Capra
4. Tao of Physics Fritz of Capra

5. Tarkasangraha of Annam Bhatta, International by V N Jha, Chinmay Foundation, Velliarnad, Ernakulam
6. Science of Consciousness Psychotherapy and Yoga Practices by RN Jha, Vidyanidhi Prakashan, Delhi, 2016
7. Himachal Pradesh History, Culture & Economy by Mian Goverdhan Singh & Prof. Dr. C.L. Gupta.

SUGGESTED DISTRIBUTION OF MARKS (Internal Assessment)		
Project Component	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1 : Indian Knowledge System (IKS)	8	25%
Unit 2 : Modern Science	6	20%
Unit 3 : Traditional knowledge	5	15%
Unit 4 : Yoga and Holistic Health Care	8	25%
Unit 5 : Himachal Pradesh: A Basic Information	5	15%
Total	32	100%

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Appendix-III

GUIDELINES FOR INTERNSHIP

Course Code	:	SI-I
Course Title	:	Internship-I
Number of Credits (Teaching Load)	:	2 (L: 0; T:0; P:0)
Prerequisites	:	-
Course Category	:	SI (Internship)

Guidelines

An internship of four weeks after 3rd semester during vacations should be undertaken in an industry/ Govt. or Pvt. Certified Agencies which are in social sector/ Govt. Skill Centres/ Institutes/ Schemes. The assessment of internship will be carried out in 4th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 4th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behavior : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

Course Code	:	SI-II
Course Title	:	Internship-II
Number of Credits (Teaching Load)	:	3 (L: 0; T:0; P:0)
Prerequisites	:	-
Course Category	:	SI (Internship)

Guidelines

An internship of Six weeks after 4th semester during vacations should be undertaken by the students in relevant Industry. The objective of this mandatory internship is to expose the students to the real world of work and get experience with the latest tools, best practices, work & culture, etiquettes and ethics followed in modern industries. The assessment of internship will be carried out in 5th semester. The faculty members must visit the internship site during the course of internship to monitor the progress of the students.

Evaluation Criteria

The internal assessment of internship is to be carried out by the Industry/ Organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the Department, if needed. The external assessment is to be done at the Institute. The department shall finalize external assessment within a month of the beginning of the 5th semester. The students have to prepare a daily diary of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behavior : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Performance in the assigned activities by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

CURRICULUM

For

DIPLOMA PROGRAMME

in

MECHANICAL ENGINEERING

3rdYear (5th & 6th Semester)

FOR THE STATE OF HIMACHAL PRADESH



Prepared by

Composite Curriculum Development Centre

Directorate of Technical Education,

Vocational & Industrial Training, Sundernagar (H.P.)

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THREE YEAR DIPLOMA
IN
MECHANICAL ENGINEERING

SALIENT FEATURES

Programme	Diploma in Mechanical Engineering
Duration	Three years (Six Semesters)
Entry Qualification	As prescribed by H.P. Takniki Shiksha Board /AICTE
Intake	As approved by H.P. Takniki Shiksha Board
Pattern	Semester System

Definition of Credit:

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

Course code and definition:

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

List of Programme Core Courses [PC]

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	DCS	P		
1	MEPC301	Fluid Mechanics &Hydraulic Machinery	2	2	0	V	2
2	MEPC303	Advanced Manufacturing Processes	2	2	0	V	2
3	MEPC305	Theory of Machines & Mechanisms	3	2	0	V	3
	MEPC307	Automotive Lab	0	0	2	V	1
4	MEPC309	Fluid Mechanics &Hydraulic Machinery Lab	0	0	2	V	1
5	MEPC311	Manufacturing Engineering Lab-III	0	3	2	V	1
6	MEPC302	Design of Machine Elements	3	2	0	VI	3
7	MEPC304	CAD/CAM Lab	0	2	2	VI	1
8							
Total Credits							14

List of Program Elective Courses [PE]

S.No	Code No.	Course Title	Hours per week			Semester	Credits
			L	DCS	P		
1	MEPE301-1	Computer Integrated Manufacturing	3	1	0	V	3
2	MEPE301-2	Elements of Refrigeration & Air Conditioning	3	1	0	V	3
3	MEPE301-3	Material handling system	3	1	0	V	3
4	MEPE302-1	Computer Aided Design and Manufacturing	3	1	0	VI	3
5	MEPE302-2	Foundry Technology	3	1	0	VI	3
6	MEPE302-3	Welding Technology	3	1	0	VI	3
Total Credits							6

PROGRAMME OUTCOMES (POs)

P01	Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
P02	Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.
P03	Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
P04	Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
P05	Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.
P06	Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities
P07	Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

Programme: Programme means Diploma Programme that is Diploma in Mechanical Engineering, which is of three years duration.

PROGRAMME SPECIFIC OUTCOMES (PSO's)

On satisfactory completion of the program, a student should able to:

PSO Designation number	Type	Description
PSO 1	Specialization knowledge	Identify, analyze and solve real-life problems by applying the knowledge in Mechanical Engineering.
PSO 2	Employability	Plan and develop mechanical systems and intelligent tools to excel in the field of Mechanical engineering with an aspire to become a brand name in industry and society.
PSO 3	Ethics and Values	Find solutions to global issues faced by the society through engineering and technology innovations by upholding professional ethics and social values.

STUDY AND EVALUATION SCHEME
SEMESTER WISE DETAILED CURRICULUM
SEMESTER V

S.NO.	CATEGORY	CODE NO.	COURSE TITLE	HOURS PER WEEK			TOTAL CONTACT HRS/WEEK	CREDIT	MARKS IN EVALUATION SCHEME							TOTAL MARKS	
				L	DCS	P			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
									TH	PR	TOTAL	TH	HRS	PR	HRS		TOTAL
1	Program core course	MEPC301	# FLUID MECHANICS & HYDRAULIC MACHINERY	2	2	0	4	2	40		40	60	3			60	100
2	Program core course	MEPC303	## ADVANCED MANUFACTURING PROCESSES	2	2	0	4	2	40		40	60	3			60	100
3	Program core course	MEPC305	## THEORY OF MACHINES & MECHANISMS	3	2	0	5	3	40		40	60	3			60	100
4	Program Elective core course (Choose one of the following)	MEPE###	###MEPE301-1: Computer Integrated Manufacturing , MEPE301-2: Elements of Refrigeration & Air Conditioning or #### MEPE301-3: Material Handling system	3	1	0	4	3	40		40	60	3			60	100
5	Program core course	MEPC307	AUTOMOTIVE LAB	0	0	2	2	1		40	40			60	3	60	100
6	Open Elective	--OE---	OPEN ELECTIVE I / MOOCs*	3	1	0	4	3	40		40	60	3			60	100
7	Program core course	MEPC309	FLUID MECHANICS & HYDRAULIC MACHINERY LAB	0	0	2	2	1		40	40			60	3	60	100
8	Program core course	MEPC311	MANUFACTURING ENGINEERING LAB III	0	3	2	5	1		40	40			60	3	60	100
9	Internship II (6 weeks) after IV sem.	SI-II	INTERNSHIP-II **	0	0	0	0	3		40	40			60	3	60	100
10	Major Project	PR301	Major Project	0	2	2	4	1		40	40			60	3	60	100
11			SCA	...		2	2			25	25						25
TOTAL				13	13	10	36	20	200	225	425	300		300		600	1025

* Guidelines w.r.t MOOCs & Open Elective Courses/Subjects are attached as Annexure-A and the list of Open Electives course along with the curriculum is attached as Annexure-B

** At the end of 4th semester students will undergo 6 week of Internship and its credits will be awarded in the 5th semester

Common with diploma in Mechanical Engineering (R & AC), ## Common with diploma in Mechanical Engineering (R & AC), Mechatronics

Common with diploma in Mechanical Engineering (R & AC), Mechatronics, Mechanical Engineering (Tool & Die)

Common with diploma in Mechanical Engineering (Tool & Die)

**STUDY AND EVALUATION SCHEME
SEMESTER WISE DETAILED CURRICULUM**

SEMESTER VI

S.NO.	CATEGORY	CODE NO.	COURSE TITLE	HOURS PER WEEK			TOTAL CONTACT HRS/WEEK	CREDIT	MARKS IN EVALUATION SCHEME								TOTAL MARKS
				L	DCS	P			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
									TH	PR	TOTAL	TH	HRS	PR	HRS	TOTAL	
1	Program core course	MEPC302	# DESIGN OF MACHINE ELEMENTS	3	2	0	5	3	40		40	60	3			60	100
2	Program core course	MEPC304	CAD/CAM LAB	0	2	2	4	1		40	40			60	3	60	100
3	Program Elective core course (Choose one of the following)	MEPE###	##MEPE302-1: Computer Aided Design & Manufacturing, MEPE302-2: Foundry Technology or MEPE302-3: Welding Technology	3	1	0	4	3	40		40	60	3			60	100
4	Humanities & Social Science course	HS302	ENTERPRENEURSHIP AND START- UP'S **	4	0	0	4	4	40		40	60	3			60	100
5	Open Elective	--OE---	OPEN ELECTIVE II *	3	1	0	4	3	40		40	60	3			60	100
6	Open Elective	--OE---	OPEN ELECTIVE III *	3	1	0	4	3	40		40	60	3			60	100
7	Mandatory course	AU302	INDIAN CONSTITUTION **	2	0	0	2	0	40		40	60	3			60	100
8	Major Project	PR302	Major Project	0	0	6	6	3		40	40			60	3	60	100
9	Seminar	SE302	Seminar	0	0	2	2	1		100	100						100
10			SCA	...	.....	1	1			25	25						25
TOTAL				18	7	11	36	21	240	205	445	360		120		480	925

* Guidelines w.r.t Open Elective Courses/Subjects are attached as Annexure-A and the list of Open Electives course along with the curriculum is attached as Annexure-B

Common with diploma in Mechanical Engineering (R & AC)

#Common with diploma in Mechanical Engineering (R & AC), Mechanical Engineering (Tool & Die)

** HS 302 and AU 302 common with other Branches

SEMESTER V

Course Code	:	MEPC301
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY
Number of Credits	:	2 (L:2, DCS:2, P:0)
Pre requisites	:	NIL
Course Category	:	PC

Course Objectives:

- To understand fluid flow & related machinery for power generation, water supply and irrigation.
- To Select and use appropriate flow measuring device.
- To Select and use appropriate pressure measuring device.
- To understand and analyze the performance of pump and turbines.

Course Content:

UNIT-I (14Hrs)

Properties of fluid : Density, Specific gravity, Specific Weight, Specific Volume, Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility.

Fluid Pressure & Pressure Measurement: Fluid pressure, Pressure head, Pressure intensity, Concept of vacuum and gauge pressures, atmospheric pressure, absolute pressure, Simple and differential manometers, Bourdan pressure gauge, (Simple problems on Manometers only).

Unit-II: (14Hrs)

Fluid Flow: Types of fluid flows, Path line and Stream line, Continuity equation, Bernoulli's theorem for ideal fluid, Principle of operation of Venturimeter, Orifice meter and Pitot tube, Derivations for discharge, coefficient of discharge and simple numerical problems.

Flow Through Pipes: Laminar and turbulent flows; Darcy's equation and Chezy's equation for frictional losses (Formula for the above terms without proof), Minor losses in pipes, Hydraulic gradient and total gradient line, Simple Numerical problems to estimate losses only.

Unit-III: (10Hrs)

Impact of jets: Impact of jet on fixed vertical, moving vertical flat plates, Impact of jet on curved vanes with special reference to turbines, Simple Numerical on work done and efficiency.

Unit-IV: (14Hrs)

Hydraulic Turbines: Layout of hydroelectric power plant, Features of Hydro electric power plant, Classification of hydraulic turbines, Selection of turbine on the basis of head and discharge available, Construction and working principle of Pelton wheel, Francis and Kaplan turbines, Draft tubes – types and construction, Concept of cavitation in turbines, Calculation of Work done, Power, efficiency of turbines, Unit quantities (Formula only) and simple numerical.

Unit-V: (12Hrs)

Centrifugal Pumps (Problems omitted): Principle of working and applications, Types of casings and impellers, Concept of multistage, Concept of Priming and, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency.

Reciprocating Pumps (Problems omitted): Construction, working principle and applications of single and double acting reciprocating pumps, Concept of Slip, Negative slip, Cavitation and separation.

Reference Books:

1. Fluid Mechanics & Hydraulic Machines, S.S. Rattan, Khanna Publishing House, New Delhi
2. Hydraulic, fluid mechanics & fluid machines–Ramamrutham S, Dhanpath Rai and Sons, New Delhi.

3. Hydraulics and fluid mechanics including Hydraulic machines–Modi P.N. and Seth S.M., Standard Book House.
4. One Thousand Solved Problems in Fluid Mechanics– K. Subramanya, Tata Mc Graw Hill.
5. Hydraulic, fluid mechanics & fluid machines–S. Ramamrutham, Dhanpat Rai and Sons, New Delhi
6. Fluid Mechanics and Hydraulic Machines–R.K. Bansal, Laxmi Publications, New Delhi

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

C01	Measure various properties such as pressure, velocity, flow rate using various instruments.
C02	Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems.
C03	Describe the construction and working of turbines and pumps.
C04	Test the performance of turbines and pumps.
C05	Plot characteristics curves of turbines and pumps.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	12
2	14	12
3	10	12
4	14	12
5	12	12
Total	64	60

- **Common with diploma in Mechanical Engineering (Refrigeration & Air Conditioning)**

Course Code	:	MEPC303
Course Title	:	ADVANCED MANUFACTURING PROCESSES
Number of Credits	:	2(L:2, DCS:2, P:0)
Prerequisites	:	Basic Mechanical Engineering, Manufacturing Engineering
Course Category	:	PC

Course Objectives:

- To know the functions of Jigs and Fixtures.
- To know the applications of jig-boring machines.
- To identify different fabrication methods of plastic processing viz., sheetforming, blow moulding, laminating and reinforcing of plastics.
- To distinguish between non-conventional machining and traditional machining processes.
- To know about the advancements in the area of manufacturing and production processes.
- To impart knowledge & skills necessary for working in modern manufacturing environment.
- To get familiarized with working principles and operations performed on-traditional machines, machining center, SPM, automated machines and maintenance of machine tools.

Course Content:

UNIT-I:

(15Hrs)

Jigs & Fixtures: Definition of jig; Types of jigs: Leaf jig, Box and Handle jig, Template jig, Plate jig, Indexing jig, Universal jig, Vice jigs; General consideration in the design of drill jigs; Drill bush; Types of fixtures: Vice fixtures, Milling fixtures, Boring fixtures, Grinding fixtures; Basic principles of location; Locating methods and devices; Basic principles of the clamping; Types of clamps: Strap clamps, Cam clamps, Screw clamps, Toggle clamps, Hydraulic and Pneumatic clamps.

Unit-II:

(10Hrs)

Plastic Processing: Processing of plastics; Moulding processes: Injection moulding, Compression moulding, transfer moulding; Extruding; Casting; Fabrication methods-Sheet forming, Blow moulding, Laminating plastics(sheets, rods & tubes), Reinforcing; Applications of Plastics.

Unit-III:

(13Hrs)

Modern Machining Processes: Principle, Description and applications of Ultrasonic Machining, Electric Discharge Machining, Wire cut EDM, Abrasive Jet Machining, Laser Beam Machining, Electro Chemical Machining.

Unit-IV:

(13Hrs)

CNC Milling Machines: Vertical and horizontal machining center: Constructional features, Axis identification, Electronic control system. Automatic tool changer and tool magazine. CNC programming: Preparatory functions (G code), miscellaneous functions (M code), Part programming.

Unit-V:

(13Hrs)

Special Purpose Machines (SPM): Concept, General elements of SPM, Productivity improvement by SPM, Principles of SPM design.

Maintenance of Machine Tools: Types of maintenance, Repair cycle analysis, Repair complexity, Maintenance manual, Maintenance records, Housekeeping. Introduction to Total Productive Maintenance(TPM).

Reference Books:

- Production Technology–HMT, Bangalore, Tata Mc-Graw Hill
- CNC machines–Pabla B.S. & M. Adithan, New Age international limited.

3. Non conventional Machining–P.K. Mistra, Narvasa Publishing House
4. Manufacturing Processes– Begman & Amsted, John Willey and Sons.
5. Advanced manufacturing technology–David L. Goetsch
6. Exploring Advanced Manufacturing Technologies–Stephen F.Krar & Arthur Gil,Industrial Press

Course outcomes:

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

C01	Know the Operation and control of different advanced machine tools and equipment.
C02	Produce jobs as per specified requirements by selecting the specific machining process.
C03	Develop the mind set for modern trends in manufacturing and automation.
C04	Identify the different fabrication methods viz. , sheet forming, blow moulding, laminating and reinforcing of plastics.
C05	Know different non-traditional machining processes, CNC milling machines, special purpose machines.
C06	Work as maintenance engineer.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	15	16
2	10	08
3	13	12
4	13	12
5	13	12
Total	64	60

Common with diploma in Mechanical Engineering (R & AC), Mechatronics

Course Code	:	MEPC305
Course Title	:	THEORY OF MACHINES & MECHANISMS
Number of Credits	:	3 (L: 3, DCS:2, P:0)
Prerequisites	:	Engineering Mechanics
Course Category	:	PC

Course Objectives:

- To understand different types of cams and their motions and also to draw cam profiles for various motions.
- To understand the mechanism of various types of drives available for transmission of power.
- To understand the design of Brakes, Dynamometers, Bearings and Clutches and their function and working.
- To understand the need for balancing of masses in the same plane
- To know different types of governors.

Course Content:

UNIT I:

(14Hrs)

Cams and Followers: Concept; Definition and application of Cams and Followers; Classification of Cams and Followers; Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation; Drawing of profile of radial cam with knife-edge and roller follower without offset for reciprocating motion (graphical method for uniform velocity and SHM only).

UNIT II:

(17Hrs)

Power Transmission (Derivations omitted): Types of Drives: Belt Drives - flat belt, V- belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip and Creep; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Formula without proof) (Simple numerical); Chain Drives-Advantages & Disadvantages;; Gear Drives – Spur gear terminology; Types of gears and gear trains; Train value & Velocity ratio for simple and compound gear train.

UNIT III:

(17Hrs)

Flywheel and Governors(Problems omitted): Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine; Co-efficient of fluctuation of energy, Coefficient of fluctuation of speed and its significance; Governors-Types and explanation with neat sketches (Centrifugal, Watt and Porter); Concept, function & Terminology of Governors; Comparison between Flywheel and Governor.

UNIT IV:

(18Hrs)

Brakes, Clutches & Bearings(Problems and derivations omitted): Function of brakes; Types of brakes; Comparison between brakes and dynamometers; Construction and working of i) shoe brake, ii) Band Brake, iii) Disc Brake; Concept of Self Locking & Self energizing brakes; Clutches- Function of Clutch and its application; Construction and working of i) Single plate clutch, ii) Multi plate clutch, iii) Centrifugal Clutch and iv) Cone clutch; Bearings – i) Simple Pivot, ii) Collar Bearing, iii) Conical pivot.

UNIT V:

(14Hrs)

Balancing & Vibrations(Problems omitted): Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane; Vibrations, its type and concept of damping ;Causes of vibrations in machines; their harmful effects and remedies.

Reference Books:

1. Theory of machines–S.S.Rattan, Tata McGraw-Hill publications.
2. Theory of machines–R.K. Bansal, Laxmi publications

3. Theory of machines–R.S. Khurmi & J.K.Gupta, S.Chand publications.
4. Dynamics of Machines–JBKD as, Sapna Publications.
5. Theory of machines–Jagdish lal, Bombay Metro–Politan book Ltd.

Course outcomes:

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

C01	Know different machine elements and mechanisms.
C02	Understand Kinematics and Dynamics of different machines and mechanisms.
C03	Select Suitable Drives and Mechanisms for a particular application.
C04	Appreciate concept of balancing and Vibration.
C05	Develop ability to come up with innovative ideas.
C06	Understand different types of cams and their motions and also draw cam profiles for various motions

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	10
2	17	14
3	17	12
4	18	14
5	14	10
Total	80	60

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 Common with diploma in Mechanical Engineering (R & AC), Mechatronics

Course Code	:	MEPC307
Course Title	:	AUTOMOTIVE LAB
Number of Credits	:	1 (L:0, DCS:0, P:2)
Prerequisites	:	NIL
Course Category	:	PC

- To understand the basic structure and components of an automobile.
- To understand the concepts of cooling and lubricating systems.
- To understand the concepts of Ignition and transmission and steering systems.
- To understand the classification and necessity of suspension system.
- To identify different special vehicles.

LIST OF PRACTICALS

1. Study of different types of clutches and adjust the clutch pedal play.
2. Study of front axle, rear axle and differential of an automobile.
3. Study of different types of gear box.
4. Study of steering system of the automobile.
5. Study of hydraulic brake system of an automobile, bleeding of hydraulic brakes.
6. Procedure of rotation of wheels, balancing of wheels and alignment of wheels.
7. Study of drive train of Electric Vehicles and its various parts.
8. Spark plug cleaning and gap setting.
9. Driving practice on four wheelers one hour/student in the semester.

Reference Books:

1. Automobile Engineering Voll,II, Kirpal Singh, Standard Publishers Distributors, Delhi.2012.
2. Automobile Mechanics ,A.K.Babu, S.C.Sharma, Khanna Publications, New Delhi
3. Automotive Mechanics: Principles and Practices, Joseph Heitner, East West Press
4. Automotive Mechanics, S.Srinivasan,2nd Edition, Tata McGraw Hill
5. Automobile Engineering Voll and VollI, K.M.Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

Course outcomes

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

C01	Identify the components of an automobile with their working.
C02	Explain the concepts of cooling and lubricating systems.
C03	Study of drive train of Electric Vehicles and its various parts.
C04	Identify different suspension systems and their applications.
C05	To have basic knowledge of four wheeler driving skill.

Course Code	:	MEPC309
Course Title	:	FLUID MECHANICS & HYDRAULIC MACHINERY LAB
Number of Credits	:	1(L:0, P:2)
Prerequisites	:	Fluid Mechanics & Hydraulic Machinery
Course Category	:	PC

Course Objectives:

- To calibrate the given flow measuring device.
- To apply the knowledge acquired in theory subject.
- To analyse the performance of turbines and pumps.

Course Content :

S.No.	Topics for practice
I	Measurement of pressure head by employing. i) Piezometer tube ii) U- tube manometer iii) Differential U- tube Manometer.
II	Verification of Bernoulli's theorem.
III	Determination of Coefficient of Discharge of Venturimeter.
IV	Determination of Coefficient of Discharge, coefficient of contraction and coefficient of velocity of Orifice meter.
V	Determination of coefficient of friction of flow through pipes.
VI	Determination of minor losses of flow through pipes.
VII	Calibration of pressure gauge using dead weight pressure gauge tester.
VIII	Conduct performance test on centrifugal pump.
IX	Study a single acting reciprocating pump.
X	Study of Pelton wheel and Francis/ Kaplan turbine with the help of models.

Reference Books: N.Kumara Swamy , Fluid Mechanics and Machinery Laboratory Manual, Charotar Publishing House Pvt.Ltd., ANAND388 001, Ed. 2008

Course outcomes:

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

C01	Measure various properties such as pressure, velocity, flow rate using various instruments.
C02	Calculate different parameter such as co-efficient of friction, power, efficiency etc. of various systems.
C03	Understand the need and importance of calibration of pressure gauges.
C04	Describe the construction and working of turbines and pumps.
C05	Understand the concept of turbines and pumps.

Course Code	:	MEPC311
Course Title	:	MANUFACTURING ENGINEERING LAB-III
Number of Credits	:	1 (L:0, DCS:3, P:2)
Prerequisites	:	Basic Mechanical Engineering, Manufacturing Engineering
Course Category	:	PC

Course Objectives:

- To know the working of milling machines and be in a position to operate the same.
- To practice different operations on milling machines.
- To know about preventive maintenance of Machines.
- To prepare job by forging methods.
- To practice advance welding operations.

Note:- Demonstration of all machines should be given before starting the practical. The instructor should explain parts of machine, work & tool holding devices, different types of cutting tools and safety measures.

LIST OF PRACTICALS

1. Job on producing a rectangular block by milling to a given accuracy of 0.1 mm to 0.02mm.
2. To prepare a slot on one face of a job with a slotting cutter/ side and face millingcutter.
3. Use of form milling cutter to make a contour on job-2.
4. Generation of spur gear teeth on a round bar.
5. Making a square / hexagonal headed bolt by drop forging.
6. Fabrication of circular job using TIG welding.
7. Fabrication of a butt/ lap joint using MIG welding.
8. Grinding of milling cutters etc. on a tool and cutter grinder
9. Dismantling some of the components of Milling machines and service, assemble thesame
10. Exercise on lathe of knurling, parting, threading operations.

Reference Books:

1. Elements of Workshop Technology (Volume-I & Volume-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, 5th edition, Tata McGraw Hill, New Delhi.

Course Outcomes:

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

CO1	Produce articles of industrial applications such as Spur gear, square headed bolt, V-block.
CO2	Perform different operations on milling machines.
CO3	Perform more lathe operations.
CO4	Practice advance welding operations.

Course Code		SI-II
Course Title		Internship-II
Number of Credits (Teaching Load)		3 (L : 0, DCS : 0, P : 0)
Prerequisites		
Course Category		

Guidelines:

An internship of 6 weeks during vacations after 4 th semester should be undertaken by the students in relevant industry. The objective of this mandatory internship is to expose the students to the real world of work and get experience with the latest tools, best practices, work & culture, etiquettes and ethics followed in modern industries. The assessment of internship will be carried out in the 5th semester.

Course Outcomes

After completing this course the students will be able to :

- CO-1. Get first hand experience of the culture and practices of real world of work
- CO-2. Appreciate time management, teamwork, adaptability and project management
- CO-3. Improve skills, confidence, competency in specific area of career interests
- CO-4. Able to earn a job reference for their behavior and performance in real projects

Evaluation Criteria

The internal assessment of internship is to be carried out by the industry/ organization where the students have undergone the internship. The internal assessment done by the industry/ organization may be rationalized by the department, if needed. The external assessment is to be done at the institute. The department shall finalize external assessment within a month of the beginning of the 5 th semester. The students have to prepare a daily diary and report of their internship period and the same has to be submitted at the institute after completion of the internship. The students have also to present the experience gained during internship in a seminar for the purpose of external evaluation using a presentation.

(a) The assessment criteria (Internal Assessment) by the industry/ organization where the students have undergone the internship is as follows:

- Attendance and general behavior : 20%
- Daily diary maintenance : 20%
- Initiative and participative attitude during internship : 20%
- Assessment of internship by the industrial supervisor : 40%

(b) The assessment criteria (External Assessment) by the institute is as follows:

- Presentation : 60%
- Report : 20%
- Viva : 20%

Course Code	PR301
Course Title	Major Project
Number of Credits (Teaching Load)	1 (L : 0, DCS : 2, P : 2)
Prerequisites	
Course Category	PR (Project Work)

Course Learning Objectives

Project work inculcates skills like problem-solving, creative thinking, design thinking, time-management, planning, teamwork, leadership, presentation, report-writing, communication etc. The final project outcome instills a sense of achievement and a feeling of self-confidence in the students. The objective of this course is to encourage the students to solve some real-world problem of some organization or start on their own startup ideas and transform it into reality by the time they complete their diploma Programme.

Course Outcomes

After completing this course the students will be able to :

- CO-1. Apply basic engineering processes in developing a complete project.
- CO-2. Conceive, incubate and present a potential startup idea.
- CO-3. Prepare project proposal, system study and requirement specification reports.
- CO-4. Present the work carried out in the project in front of reviewers.

Guidelines

1. Major projects 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. Main objective of the major project is to provide the students with an opportunity to develop a complete project by applying the principles of Engineering, Project Management and the industrial experience gained during their internships.
2. The major project is spread across a period of two semesters giving students ample time to realize a complete project with documentation or transform their ideas of startups into reality. The requirement analysis and designing part of the project must be completed in the 5th semester.
3. The students may be provided support in preparing project proposals, startup incubation and awareness about various government initiatives to promote startups. At least one expert lecture on the concepts of startup and government initiatives to promote startups must be arranged in this semester.
4. The project guide must help students to identify their major project works and make use of project management best practices in execution of project activities.
5. A project work may be carried out by a team of 3 to 5 students with a well-defined role of each student within the team.

SUGGESTED DISTRIBUTION OF MARKS (Internal Assessment)	
Project Component	Marks Allotted (%)
1. Synopsis and Project Title Selection	20%
2. Initiative in Performing Project Tasks	30%
3. Attendance and Punctuality	20%
4. Outcome of the Completed Stages of the Project	30%

SUGGESTED DISTRIBUTION OF MARKS (External Assessment)	
Project Component	Marks Allotted (%)
1. Project Demonstration	40%
2. Project Presentation	40%
3. Viva	20%

SEMESTER VI

Course Code	:	MEPC302
Course Title	:	Design of Machine Elements
Number of Credits	:	3(L:3, DCS:2, 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.

Note: a) Use of design data book during the examination is allowed.

b) The paper setter should provide all the relevant data for the machine design numerical in the question paper.

Course Content:

UNIT-I:

(14Hrs)

Introduction to Design: Machine Design philosophy; General Design Procedure; General Considerations in Machine Design; Characteristics of a good designer; Fundamentals: Types of loads, concepts of stress, Strain, Types of Stresses; Crushing; Bending and Torsion; Creep strain and Creep Curve; Fatigue; S-N curve; Endurance Limit; Factor of Safety; Stress Concentration; Properties of Engineering materials; standardization and advantages of standardization; Use of design data book; Use of standards in design; Selection of Material; Criterion of material selection.

UNIT-II:

(16Hrs)

Design of Cotter and Knuckle Joint: Cotter Joint: Different parts of the Spigot and socket joint; Design of Cotter joint; Design of Socket, Design of spigot, Design of cotter, design of rod.

Knuckle Joint: Different parts of the joint, material used for the joint, Design of knuckle joint; Design of rod, Design of pin, Design of single eye, design of double eye.

Antifriction Bearings (problems and derivations omitted): Classification of Bearings; Sliding contact & Rolling contact; Terminology of Ball bearings: Life Load relationship, Basic static load rating and Basic dynamic load rating, limiting speed (concept only).

UNIT-III:

(16Hrs)

Design of shaft: Types of Shafts; Shaft materials; Type of loading on shaft, Standard Sizes; Design of Shafts (Hollow and Solid) subjected to torsion only, using strength and rigidity criteria; Determination of shaft diameter (Hollow and solid) subjected to bending; Determination of shaft diameter (hollow and solid) subjected to combined torsion and bending.

Design of Keys and Spur Gear: Types of key, Function of key, Forces acting on sunk keys, Failure of sunk key (by shearing and Crushing), Design of Sunk Keys; Effect of Keyways on strength of shaft.

Spur Gear Nomenclature, Design Considerations. (No derivation and Problem on Spur gear)

UNIT-IV:

(20Hrs)

Design of Couplings: Necessity of a coupling, advantages of a coupling, Types of coupling, Design of Protected and Unprotected type Flange Coupling

Design of Riveted and Welded Joints: Types of riveted joints, Possible failure of riveted joints, Design of single riveted and double riveted lap and butt joint (zigzag and chain riveting), strength and efficiency of riveted joints. Common types of welded joints, Simple design for V butt welded joints, design for transverse fillet, parallel fillet, combination fillet welded joint

Course Code	:	MEPC304
Course Title	:	CAD/CAM LAB
Number of Credits	:	1 (L:0, DCS:2, P:2)
Prerequisites	:	Computer Aided Machine Drawing
Course Category	:	PC

Course Objectives:

- To understand the fundamentals and use CAD.
- To conceptualize drafting and modeling in CAD.
- To interpret the various features in the menu of solid modeling package.
- To synthesize various parts or components in an assembly.
- To prepare CNC programs for various jobs.

Course Content:

S.No.	Topics for practice
PART-A	Introduction: Part modelling; Datum Plane; constraint; sketch; dimensioning; extrude; revolve; sweep; blend; protrusion; extrusion; rib; shell; hole; round; chamfer; copy; mirror; assembly; align; orient.
	Exercises: 3D Drawings of 1). Geneva Wheel ; 2). Bearing Block; 3). Bushed bearing; 4). Gib and Cotter joint; 5). Screw Jack; 6). Connecting Rod: Note: Print the orthographic view and sectional view from the above assembled 3D drawing. (at least four drawings to be prepared)
PART-B	CNC Programming and Machining: Introduction; 1). Study of CNC lathe, milling; 2). Study of international standard codes: G-Codes and M-Codes; 3). Format – Dimensioning methods; 4). Program writing – Turning simulator – Milling simulator, IS practice – commands menus; 5). Editing the program in the CNC machines; 6). Execute the program in the CNC machines; Exercises: Note: Print the Program from the Simulation Software and make the Component in the CNC Machine.
	CNC Turning Machine: (Material: Aluminum/Acrylic/Plastic rod) 1. Using Linear and Circular interpolation – Create a part program and produce component in the Machine. 2. Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine. 3. Using canned cycle – Create a part program for thread cutting, grooving and produce component in the Machine.
	CNC Milling Machine (Material: Aluminum/Acrylic/Plastic) 1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine. 2. Using canned cycle – Create a part program for drilling, tapping, counter sinking and produce component in the Machine. 3. Using sub program – Create a part program for mirroring and produce component in the Machine.

Reference Books:

1. Machine Drawing – P.S. Gill S.K. Kataria & Sons, Delhi., 17th Revised edition, 2001
2. Mechanical Draughtsmanship – G.L. Tamta Dhanpat Rai & Sons, Delhi, 1992
3. Inside Auto CAD – D. Raker and H. Rice, BPB Publications, New Delhi, 1985
4. CAD/CAM/CIM – P. Radhakrishnan, S. Subramaniyan & V. Raju, New Age International Pvt. Ltd., New Delhi, 3rd Edition,

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

C01	Explain the 3D commands and features of a CAD software
C02	Create 3D solid model and find the mass properties of simples solids
C03	Demonstrate the working of CNC turning and milling machine
C04	Develop the part program using simulation software for Lathe and Milling
C05	Assess the part program, edit and execute in CNC turning and machining centre

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Course Code	:	PR302
Course Title	:	Major Project
Number of Credits (Teaching Load)	:	3 (T : 0, DCS : 0, P : 6)
Prerequisites	:	Major Project (PR301)
Course Category	:	PR (Project Work)

Course Learning Objectives

Project work inculcates skills like problem-solving, creative thinking, time-management, planning, teamwork, leadership, presentation, report-writing, communication etc. The objective of this course is to encourage the students to solve some real problem of some organization or start on their own startup ideas and transform it into reality by the time they complete their diploma.

Course Outcomes

After completing this course the students will be able to :

CO-1. Apply basic engineering processes in developing a complete project.

CO-2. Conceive, incubate and present a potential startup idea.

CO-3. Design, develop, test and implement a complete project.

CO-4. Present the work carried out in the project in front of reviewers.

Guidelines

1. Major projects 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. Main objective of the major project is to provide the students with an opportunity to develop a complete project by applying the principles of Software Engineering, Project Management and the industrial experience gained during their internships.

2. The major project is spread across a period of two semesters giving students ample time to realize a complete project with documentation or transform their ideas of startups into reality. The requirement analysis and designing part of the project must have been completed in the 5th semester. The implementation, testing and documentation part of the project is to be carried out in the 6th semester.

3. The project guide must help students in selecting the appropriate tools and technologies for project implementation and the progress of the students must be monitored on a regular basis.

4. The students must properly document the project work as per the engineering documentation standards. A project report has to be prepared by each student as per the standard format prescribed by the concerned department.

SUGGESTED DISTRIBUTION OF MARKS (Internal Assessment)	
Project Component	Marks Allotted (%)
1. Initiative in Performing Project Tasks	30%
2. Attendance and Punctuality	20%
3. Final Outcome as per Project Objectives	30%
4. Report Writing	20%

SUGGESTED DISTRIBUTION OF MARKS (External Assessment)	
Project Component	Marks Allotted (%)
1. Project Demonstration	40%
2. Project Presentation	20%
3. Project Report	20%
4. Viva	20%

Course Code	:	SE302
Course Title	:	Seminar
Number of Credits	:	1 (L:0,DCS:0, P:2)
Prerequisites	:	NIL
Course Category	:	SE

Course Learning Objectives

To provide a platform for the students to share their ideas about some emerging topic in the field of Computer Engineering with their peers. To improve the public speaking skills of the students.

Course Outcomes

After completing this course the students will be able to :

C01	Prepare a presentation about the topic of their choice.
C02	Present their ideas/ thoughts to the audience.
C03	Demonstrate their skill in handling audience queries.

Guidelines

1. The students should be assigned emerging topics in the field of their interests for their seminars.
2. A seminar schedule should be prepared for the entire semester and conveyed to the students.
3. The students have to prepare at least 30 slides presentation for their seminar.
4. Each student has to individually present the seminar in front of his/ her classmates and faculty.
5. A proper arrangement for presentation may be done with a multimedia projector and a computer system.
6. A student may be allotted time of 15 minutes for presentation and 5 minutes for Q&A session.
7. The students in the audience may ask the questions on the seminar topic from the presenter after the seminar.

SUGGESTED DISTRIBUTION OF MARKS (External Assessment)	
Project Component	Marks Allotted (%)
1. Seminar Topic Relevance	10%
2. Execution of Seminar	40%
3. Quality of Presentation	10%
4. Attendance and Punctuality	10%
5. Exhibition of Public Speaking Skill	10%
6. Adherence to Timing	10%
7. Engagement of Audience	10%

Appendix-I

PROGRAMME ELECTIVE COURSES

Course Code	:	MEPE301-1
Course Title	:	COMPUTER INTEGRATED MANUFACTURING
Number of Credits	:	3 (L:3,DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

- To understand the basic concept of Computer integrated manufacturing.
- To understand the hardware and software applied in product modelling.
- To understand the applications of computer based technologies in manufacturing processes.
- To understand the flexible manufacturing system.

Course Content:

UNIT-I

(13Hrs)

Concept of Computer Integrated Manufacturing (CIM); Basic components of CIM; Distributed database system; distributed communication system, computer networks for manufacturing; future automated factory; social and economic factors

Unit-II:

(11Hrs)

Computer Aided Design (CAD): CAD hardware and software; product modelling, automatic drafting; engineering analysis; FEM design review and evaluation; Group Technology Centre.

Unit-III:

(15Hrs)

Computer Aided Manufacturing (CAM), Computer assisted NC part programming; Computer assisted robot programming; computer aided process planning (CAPP); computer aided material requirements planning (MRP)

Unit-IV:

(11Hrs)

Computer aided production scheduling; computer aided inspection planning; computer aided inventory planning, Flexible manufacturing system(FMS); concept of flexible manufacturing.

Unit-V:

(14Hrs)

Integrating NC machines, robots, AGVs, and other NC equipment; Computer aided quality control; computer aided forecasting; office automation

Reference Books:

1. CAD ,CAM, CIM-P. Radhakrishnan and S. Subramanyan, New Age International Publishers.
2. Computer Integrated Manufacturing- Paul G .Rankey, Prentice Hall.
3. Robotics Technology and Flexible Automation–S.R .Deb, Tata McGraw Hill.

Course outcomes:

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

C01	Understand the formulation of Linear Programming
C02	Analyze and Convert the problem into a mathematical model.
C03	Understand the dual LP and Primal Dual relation problems
C04	Understand and implement the transportation problems at workplace
C05	Solve the assignment problems, solving linear programming approach using software

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	13	12
2	11	08
3	15	14
4	11	12
5	14	14
Total	64	60

Common with diploma in Mechanical Engineering (R & AC), Mechatronics, Mechanical Engineering (Tool & Die)

Course Code	:	MEPE301-2
Course Title	:	ELEMENTS OF REFRIGERATION AND AIR-CONDITIONING
Number of Credits	:	3 (L:3,DCS:1, P:0)
Prerequisites	:	Thermal Engineering-I
Course Category	:	PE

Course Objectives:

- To understand the basics of Refrigeration cycles.
- To understand basics of vapour compression and vapour absorption systems.
- To identify components and refrigerants and lubricants of a refrigeration system.
- To understand control strategies for refrigeration system.
- To understand the basics about air conditioning systems.

Course Content:

UNIT-I:

(13Hrs)

Introduction to Refrigeration: Definition of Refrigeration; Refrigerating effect-unit of refrigeration-Coefficient of performance; Carnot refrigeration Cycle; Air refrigeration-Bell-Coleman cycle ,PV & TS diagram; Advantage and disadvantages in air refrigeration;(Simple problems on Carnot refrigeration cycle only)

Unit-II:

(14Hrs)

Refrigeration systems (Problems omitted): Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the vapour compression cycle on P-H & T-S Diagram;Expression for Refrigerating effect, work done and power required; Types of Vapour Compression cycle; Effects of superheating and sub cooling, its advantages and disadvantages; Simple Vapour absorptions cycle and its flow diagram; Comparison of Vapour absorption and vapour compression system.

Unit-III:

(13Hrs)

Refrigeration equipments: Compressor - Hermetically sealed and Semi hermetically sealed compressor; Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers; Evaporators- natural convection, forced convection types.

Refrigerants and lubricants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties.

Unit-IV:

(09Hrs)

Refrigerant flow controls: Capillary tube; Automatic Expansion valve; Thermo static expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator.

Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers.

Unit-V:

(15Hrs)

Air conditioning: Introduction to Air conditioning; Factors affecting Air conditioning; Brief description of Dry Bulb Temperature, Wet bulb Temperature, Dew point temperature; Psychrometric chart and its use; Psychrometric process-sensible heating and cooling, Humidification and dehumidification; cooling and dehumidification, heating and humidification, .(Simple problems on above psychrometric processes only by using psychrometric chart); Equipment used in air conditioning cycle.

Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Servicing procedure.

Reference Books:

- 1 Refrigeration and Air Conditioning– Sadhu Singh, Khanna Book Publishing Co., New Delhi
- 2 Refrigeration and Air Conditioning–S. Domakundawar, Dhanpat Rai publications.
- 3 Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
- 4 Principles of Refrigeration–Roy J. Dossat, 5th edition, Pearson Publications, 2001.
- 5 Refrigeration and Air Conditioning–M. Zakria Baig, Premier/ Radiant Publishing House.
- 6 Refrigeration and Air Conditioning–C.P Arora, Tata McGraw Hill Education, 2000.

Course outcomes

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

C01	Define refrigeration and types of Refrigeration cycles
C02	Explain Vapour Compression and Vapour Absorption System working principles
C03	Identify the components required for refrigeration system.
C04	Identify the controlling components for a refrigeration system.
C05	Explain the working principles of Air-conditioning.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allotted
1	13	12
2	14	14
3	13	12
4	09	10
5	15	12
Total	64	60

Course Code	:	MEPE301-3
Course Title	:	MATERIAL HANDLING SYSTEM
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

- To know the operational features of the material handling equipment & its practical applications.
- To understand, select, operate and maintain the material handling equipments.
- To understand different material handling processes used in industries.
- To understand & appreciate safety instrumentation for equipment.

Course Content:

UNIT-I:

(11Hrs)

Introduction to Material Handling System: Main types of Material handling equipments & their applications; Types of load to be handled; Types of Movements; Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

UNIT-II:

(13Hrs)

Hoisting Machinery & Equipments: Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists; Construction, Working & Maintenance of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Cable cranes, Floating cranes & Cranes traveling on guide rails.

UNIT-III:

(13Hrs)

Conveying Machinery: Construction, Working & Maintenance of Traction type conveyors such as Belt conveyors, Chain conveyors, Bucket elevators; Construction, Working & Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors.

Surface Transportation Equipment: Construction, Function, Working of following Trackless equipment:- Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers.

UNIT-IV:

(12Hrs)

Components of Material Handling Systems: Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eyebolts, Lifting tackles, Lifting & Rigging practices; Load handling attachments: a) Various types of hooks-Forged, Triangular eyehooks, Appliances for suspending hooks b) Electric lifting magnet, vacuum lifter. c) Crane attachment for handling liquids/molten metals ;Construction & use of electromagnetic shoe brakes, Thruster operated shoe brakes, Control brakes.

UNIT-V:

(15Hrs)

Mechanism used in Material Handling Equipment: Steady state motion; Starting & stop- ping of motion in following mechanisms :Hoisting mechanism, Lifting Mechanism, Traveling Mechanism, Rope & chain operated Cross-Transpose Mechanism.

Selection of Material Handling Equipment: Factors affecting choice of material handling equipment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Nature of production process involved, Specific load conditions & Economics of material handling system.

Reference Books:

1. Material handling (Principles & Practice)-Allegri T.H.,CBS Publisher, New Delhi.
2. Plant Layout & Materials Handling-Apple J.M., John Wiley Publishers.
3. Material Handling Equipment-N. Rundenko, Peace Publisher, Moscow.

4. Material Handling Equipment–M.P. Alexandrov, MIR Publisher, Moscow.
5. Material Handling Equipment–Y.I. Oberman ,MIR Publisher, Moscow.

Course outcomes

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

C01	Understand constructional & operational features of various materials handling systems.
C02	Identify, compare & select proper material handling equipment for specified applications.
C03	Know the controls & safety measures in corporate on material handling equipment.
C04	Appreciate the role of material handling devices in mechanization & automation of industrial process.
C05	Understand & appreciate safety instrumentation for equipment

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	11	10
2	13	12
3	13	12
4	12	12
5	15	14
Total	64	60

Common with diploma in Mechanical Engineering (Tool & Die)

Course Code	:	MEPE302-1
Course Title	:	COMPUTER AIDED DESIGN AND MANUFACTURING
Number of Credits	:	3 (L:3,, DCS: 1, P:0)
Prerequisites	:	Computer Aided Machine Drawing Practice
Course Category	:	PE

Course Objectives:

To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture.

- To understand concepts of drafting and modeling using CAD.
- To understand the need for integration of CAD and CAM.
- To understand the concepts of flexible manufacturing system.

Course Content:

UNIT-I:

(15Hrs)

Fundamentals of CAD/CAM : Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; workstation; Graphic terminal; CAD Software: Definition of system software and application software; CAD database and structure.

Geometric Modeling: 3D-Wire frame modeling; Wire frame entities and their definitions; Interpolation and Approximation of curves; Concept of Parametric and Non-parametric representation of curves;

Unit-II:

(15Hrs)

Surface Modeling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parameterization of surface patch; Sub dividing; Cylindrical surface; Ruled surface; ;Spherical surface; Composite surface; Bezier surface; Solid Modelling: Definition of cell composition and; Sweep representation; Constructive solid geometry; Boundary representations.

Unit-III:

(12Hrs)

NC Control Production Systems: Numerical control; Elements of NC system; NC part programming; Methods of NC part programming; Manual part programming, Computer assisted part programming; Postprocessor; Computerized part program.

Unit-IV:

(11Hrs)

Group Technology: Part families; Parts classification and coding; Production analysis; Machine cell design; Computer aided process planning: Retrieval type and Generative type; Machinability data systems; MRP and its Benefits.

Unit-V:

(11Hrs)

Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control; Automated inspection: Off-line, On-line, Contact, Non-contact; Coordinate measuring machines; CIM system and Benefits.

Reference Books:

1. CAD/CAM Principles and Applications ,P.N. Rao, Tata McGraw-Hill
2. Computer Aided Design and Manufacturing, Groover M.P.& Zimmers Jr, Prentice hall of India
3. CAD/CAM/CIM, Radha Krishna P.& Subramanyam, Wiley Eastern Ltd

Course outcomes:

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

C01	Develop mathematical models to represent curves and surfaces and Model engineering components using solid modeling techniques.
C02	Understand geometric transformation techniques in CAD.
C03	Develop programs for CNC to manufacture industrial components.
C04	Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.
C05	Utilize Flexible manufacturing system tools.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	15	14
2	15	14
3	12	08
4	11	12
5	11	12
Total	64	60

Common with diploma in Mechanical Engineering (R & AC), Mechanical Engineering (Tool & Die)

Course Code	:	MEPE302-2
Course Title	:	FOUNDRY TECHNOLOGY
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

- To understand basics of Pattern making and foundry practice.
- To understand Sand molding and permanent die molding.
- To understand the standard foundry practices for casting of ferrous and non-ferrous materials.
- To understand the processes involving designing of molds, Castings, casting defects, inspection and testing of castings and modernization of foundries

Course Content:

UNIT-I:

(12Hrs)

Pattern Making: Materials for pattern making, Factors affecting selection, Pattern allowances, Types of patterns, Tools used for making pattern, Core prints and core boxes, Machines used in pattern making, Defects caused by pattern design.

Moulding And Core Making: Moulding sands, Principle ingredients of moulding sand, Specification and testing of moulding sand, Sand preparation, Moulding processes - Bench floor moulding, pit moulding, Hand moulding, Machine Moulding, Core sands, Types of cores, Core making, Gates and risers, Defects making caused by moulding and core making

Unit-II:

(12Hrs)

Mould and Core Drying: Mould, drying, Core Drying, Defects

Melting Practice : Construction and working of following furnaces- open hearth, air furnance(Reveratory), Cupola, Electrical arc furnance.

Unit-III:

(12Hrs)

Closing And Pouring The Moulds: venting and closing ; Ladles, pouring

Solidification Of Casting: Nucleation; Growth; Directional solidification; Pouring rate and temperature; Padding; use of chills

Unit-IV:

(16Hrs)

Casting Processes : Sand casting ;Permanent mould casting ; Slush casting; Die casting; Plaster mould casting ;Shell moulding ; Investment casting; Centrifugal Moulding; Carbon dioxide moulding; Continuous casting

Cleaning And Inspection Of Casting : Shaking of moulds; Removal of dry sand cores; Removal of extra parts; Cleaning of casting;Chipping, burning off and grinding ; Rumbling, shot blasting and hydro blast ;surface treatment; Inspection of casting

Unit-V:

(12Hrs)

Heat Treatment Of Casting: Purpose of heat treatment; Concept of annealing and quenching; Defects caused by heat treatment

Modernization Of Foundries: Foundry mechanization; Mechanized Sand preparation units; Equipment for dust and fume control; Equipment for moulding and core making; Melting, pouring and shake out units.

Reference Books:

- 1. A Text-Book of Foundry Technology by O.P. Khanna**
- 2. Foundry Technology by K.P. Sinha & D.B. Goel**
- 3. Principles of Foundry Technology by P.L. Jain**

Course outcomes:

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

C01	Understand basics of Pattern making and foundry practice.
C02	Understand Sand molding and permanent die molding.
C03	Understand the standard foundry practices for casting of ferrous and non-ferrous materials.
C04	Understand the processes involving designing of molds, Castings, casting defects, inspection and testing of castings and modernization of foundries

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	12	10
3	12	12
4	16	14
5	12	12
Total	64	60

Course Code	:	MEPE302-3
Course Title	:	WELDING TECHNOLOGY
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	PE

Course Objectives:

- To understand the basics of welding and to know about the various types of welding processes.
- To understand the principle and working of gas and arc welding processes.
- To understand the principle and working of resistance welding processes.
- To understand the concept and working of various special welding processes.
- To understand the principle and concept of Brazing and soldering, Welding of Different Materials, welding defects and testing of welded joints.

Course Content:

UNIT-I:

(14Hrs)

Introduction To Welding: Principle of welding; Classification of welding processes; Advantages, Limitations of welding; Welding applications ; Weldability.

Gas Welding: Principle of operation ; Oxyacetylene flame ; Types of flame ; Combustion of flame ; Welding Techniques ; Filler rods And fluxes for gas welding ; Gas welding equipment and accessories ; Oxygen gas cylinders ; Acetylene gas cylinders ; Acetylene gas generator ; Pressure Regulator ; Oxygen and Acetylene Hoses ; Welding Torch.

Unit-II:

(16Hrs)

Arc Welding: Arc welding process ; Striking the arc ; Arc length ; Arc blow ; Arc welding machines- types and details ; AC and DC welding and effects of polarity ; Electrodes-classification, specifications and selection ; Coated electrodes ; Welding defects.

Resistance Welding: Principle ; Advantages, disadvantages ; Applications ; Spot welding ; Seam welding ; Projection welding ; Butt Welding; Upset butt welding ; Flash butt welding ; Percussion welding

Unit-III:

(10Hrs)

Other Welding Processes: Submerged arc welding ; TIG welding ; MIG welding ; Electro slag welding ; Plasma arc welding ; Ultrasonic welding ; Thermit welding ; Atomic hydrogen welding ; Electron beam welding ; Laser beam welding.

Unit-IV:

(12Hrs)

Brazing: Principle ; Procedure ; Brazing filler alloys; Brazing fluxes; Advantages, Limitations and applications

Soldering: Principle ; Solders; Soldering fluxes; Soldering Methods; PCB Soldering

Unit-V:

(12Hrs)

Welding Of Different Materials : Welding Cast iron, Alloy Steel, tool Steel, Aluminium, Magnesium, Stainless, Copper

Weld Defects And Testing: Types of weld Defects; their causes and prevention ; Destructive testing of welds; Non Destructive tests- Fluorescent penetration test, magnetic particle test, ultrasonic test, radiographic test

Reference Books:

- 1. Manufacturing Technology: Vol. 1 - Foundry, Forming and Welding by P.N.Rao; McGraw Hill Higher Education publication**
- 2. A Text-Book of Welding Technology by O.P. Khanna**
- 3. Modern welding technology Book by Howard B. Cary**
- 4. Practical Welding Technology Book by Rudy Mohler**
- 5. Welding: Principles and Applications Book by Larry Jeffus**

Course outcomes:

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

C01	Understand the basics of welding and to know about the various types of welding processes.
C02	Understand the principle and working of gas and arc welding processes.
C03	Understand the principle and working of resistance welding processes.
C04	Understand the concept and working of various special welding processes.
C05	Understand the principle and concept of Brazing and soldering, Welding of Different Materials, welding defects and testing of welded joints.

SUGGESTED DISTRIBUTION OF MARKS

Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	12	14
2	12	14
3	12	08
4	16	12
5	12	12
Total	64	60

Appendix-II

Common Courses (V-VI Semesters)

Course Code	HS 302
Course Title	Entrepreneurship and Start-ups
Number of Credits	4(L:4, DCS:0, P:0)
Prerequisites (Course code)	None
Course Category	HS

Course Learning Objectives:

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

Course Content:

UNIT 1 - Introduction to Entrepreneurship and Start-Ups

- Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation.
- Types of Business Structures, Similarities/differences between entrepreneurs and managers.

UNIT 2 - Business Ideas and their implementation

- Discovering ideas and visualizing the business
- Activity map
- Business Plan

UNIT 3 -Idea to Start-up

- Market Analysis–Identifying the target market,
- Competition evaluation and Strategy Development,
- Marketing and accounting,
- Risk analysis

UNIT 4 –Management

- Company’s Organization Structure,
- Recruitment and management of talent.
- Financial organization and management

UNIT 5-Financing and Protection of Ideas

- Financing methods available for start-ups in India
- Communication of Ideas to potential investors–Investor Pitch
- Patenting and Licenses

UNIT 6 -Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.

Learning Outcome:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank 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. Slywotzky With Karl Weber	Headline Book Publishing, ISBN – 978-0755388974
4.	The Innovator's Dilemma: The Revolutionary Book that will Change the Way You do Business	Clayton M. Christensen	Harvard business, ISBN: 978-142219602

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- a. <https://www.fundable.com/learn/resources/guides/startup>
- b. <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/>
- c. <https://www.finder.com/small-business-finance>
- d. <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs.)	Marks Allotted
1	12	9
2	10	9
3	12	12
4	12	10
5	10	12
6	08	8
Total	64	60

Appendix-III

AUDIT COURSE

Course Code	:	AU 302
Course Title	:	Indian Constitution
No of Credits	:	0 (L: 2, T: 0, P: 0)
Pre requisite	:	Nil
Course Category	:	AU

INDIAN CONSTITUTION

Course Objectives:

1. To realise the significance of constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
2. To identify the importance of fundamental rights as well as fundamental duties.
3. To understand the functioning of Union, State and Local Governments in Indian federal system.
4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedures.

Course Contents

Unit 1 Introduction to Constitution:

- History of making of the Indian Constitution.
- Meaning and importance of the Constitution.
- Salient features and Preamble of Indian Constitution.
- Fundamental rights- meaning and limitations.
- Directive principles of state policy and Fundamental duties -their enforcement and their relevance.

Unit 2 Union Government:

- Structure of Union Government.
- Union Executive- President, Vice-president, Prime Minister, Council of Ministers.
- Union Legislature- Parliament and Parliamentary proceedings.
- Union Judiciary-Supreme Court of India – composition and powers and function.

Unit 3 State and Local Governments:

- Structure of State Government.
- State Executive- Governor, Chief Minister, Council of Ministers.
- State Legislature-State Legislative Assembly and State Legislative Council.
- State Judiciary-High court.
- Local Government-Panchayat raj system with special reference to 73rd and Urban Local Self Govt. with special reference to 74th Amendment.

Unit 4 Election provisions, Emergency provisions, Amendment of the constitution

- Election Commission of India-composition, powers and functions and electoral process.
- Types of emergency-grounds, procedure, duration and effects.
- Amendment of the constitution- meaning, procedure and limitations.

Course Outcomes:

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

1. Understand and explain the significance of Indian Constitution as the fundamental law of the land.
2. Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.
3. Analyse the Indian political system, the powers and functions of the Union, State and Local Governments in detail.
4. Understand Electoral Process, Emergency provisions and Amendment procedure.

Suggested Marks Distribution:

Units	Time Allotted (Hrs)	Marks Allotted (%)
Unit-1	8	25
Unit-2	8	25
Unit-3	10	35
Unit-4	6	15
Total	32	100

Reference Books:

1. "Introduction to the Constitution of India" by M.V. Pylee, 4th Edition, Vikas publication, 2005.
2. Ethics and Politics of the Indian Constitution by Rajeev Bhargava, Oxford University Press, New Delhi 2008
3. The Constitution of India by B.L. Fadia, Sahitya Bhawan, New Edition 2017.
4. "Introduction to the constitution of India" by Durga Das Basu (DD Basu) , (Student Edition), 19th edition, Prentice-Hall EEE, 2008.

Guidelines w.r.t Massive Open Online Courses (MOOCs)

1. A student may opt for a MOOC mode course as open elective in 5th semester after due approval of the Principal as per the recommendations of respective Head of the Department.
2. The student opting for the open elective under MOOC shall apply for the same on the prescribed proforma and may take the course only after due recommendation from the concerned HOD and approval from the Principal of the institute.
3. The MOOC course/Subject opted by the student should preferably be offered by Swayam, IITBX, Spoken Tutorials, mooKIT etc. of minimum 12 weeks duration carrying 3 credits.
4. The MOOC course opted by the student must have the provisions of continuous evaluation and examination at the end of the course.
5. The certificate issued by the MOOC provider, after successful completion of a MOOC Course/Subject clearly showing the result and credits earned is to be submitted by the student to the institute for further submission to Himachal Pradesh Takniki Shiksha Board Dharamshala well in time.
6. The details of credits earned and the marks obtained by the students is to be submitted by the institute to the Himachal Pradesh Takniki Shiksha Board Dharamshala. The credits and grades are to be reflected in the Detailed Marks Certificate (DMC) of 5th semester.

Guidelines w.r.t Open Elective

1. The students can opt only for that open elective course which is offered by other than their respective department.
2. Open Elective will be offered by each Department subject to the availability of the Infrastructure, faculty and required relevant facilities.
3. The Courses/Subjects will be offered as per the criteria fixed by the Institution.
4. Institute shall ensure that Open Elective offered to the students should be such that he/she has not studied the same in earlier semester as open elective/core subjects.
5. The contents of open elective offered by different Departments/Branches are available with the curricula of respective Departments/Branches.

Annexure-B

OPEN ELECTIVES CURRICULUM

FOR

DIPLOMA PROGRAMME

3rd Year (5th & 6th Semester)

**FOR THE STATE OF HIMACHAL
PRADESH**



N-2022

Implemented w.e.f. Session 2022-23

Prepared by:-

Composite Curriculum Development Centre

Directorate of Technical Education,

Vocational & Industrial Training, Sundernagar (H.P.)

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OPEN ELECTIVE COURSES (OE)

Sr. No.	Name of Branch offers the Open Elective	Course Code	Name of Subject	Credit (3)			Semester
				L	P	DCS	
1.	Applied Science	ASOE301	Life Skills for Professional & Personal Life(LSPPL)	3	0	1	V
		ASOE303	Industrial Water Treatment	3	0	1	V
		ASOE302	Technical communication	3	0	1	VI
		ASOE304	Composites Science & Technology	3	0	1	VI
2.	Architecture Assistantship	AROE301	Vastu-Shastra	3	0	1	V
		AROE302	Architecture Photography	3	0	1	VI
		AROE304	Sustainable Development	3	0	1	VI
3.	Automobile Engineering	AEOE 301	Vehicular Systems	3	0	1	V
		AEOE 302	Automotive Pollution and Control	3	0	1	VI
		AEOE 304	Vehicle Body Engineering	3	0	1	VI
4.	Civil Engineering	CEOE301	Project Management	3	0	1	V
		CEOE302	Engineering Geology	3	0	1	VI
		CEOE304	Disaster Management	3	0	1	VI
5.	Computer Engineering	COOE301	Introduction to e - Governance	3	0	1	V
		COOE302	Introduction to E-Commerce	3	0	1	VI
		COOE304	Computer Hardware and Peripherals	3	0	1	VI
6.	Electrical Engineering	EEOE301	Illumination Practices	3	0	1	V
		EEOE302	Energy Efficiency And Audit	3	0	1	VI
		EEOE304	Electric Traction	3	0	1	VI
7.	Electrical and Electronics Engineering	EEEOE301	Powering Building: Strategies for Electrification	3	0	1	V
		EEEOE302	Nanotechnology	3	0	1	VI
		EEEOE304	Industrial Drives	3	0	1	VI
8.	Electronics and Communication Engineering	ECOE301	PLC & Automation	3	0	1	V
		ECOE302	Satellite and Cellular Communication	3	0	1	VI
		ECOE304	Optical Fibre Technology	3	0	1	VI
9.	Information Technology	ITOE301	Cyber Laws & Ethics	3	0	1	V
		ITOE302	Fundamentals of Blockchain Technology	3	0	1	VI
		ITOE304	Multimedia Applications	3	0	1	VI
10.	Instrumentation Engineering	IEOE301	Power Plant Instrumentation	3	0	1	V
		IEOE302	Automation Solution	3	0	1	VI
		IEOE304	Computer aided Instrumentation	3	0	1	VI
11.	Mechanical Engineering	MEOE301	Renewable Energy Technologies	3	0	1	V
		MEOE302	Installation testing and Maintenance	3	0	1	VI
		MEOE304	Productio Planning and Control	3	0	1	VI

12.	Computer Engineering & Internet of Things (IoT)	IoTOE301	Software Project Management	3	0	1	V
		IoTOE302	Data Warehousing and Data Mining	3	0	1	VI
		IoTOE304	Wireless Sensor Network	3	0	1	VI
13.	Mechatronics	MAOE301	Industrial Mechatronics	3	0	1	V
		MAOE302	Robotics And Applications	3	0	1	VI
		MAOE304	Product Design	3	0	1	VI
14.	Agriculture Engineering	AGEOE301	Fertiliser Technology	3	0	1	V
		AGEOE302	Industrial Safety	3	0	1	VI
		AGEOE304	Organic and Natural Farming Practices	3	0	1	VI
15.	Electrical Engineering and Electrical Vehicle Technology	EEVOE 301	Automotive Fuel and Lubricants	3	0	1	V
		EEVOE 302	Automotive Power Train	3	0	1	VI
		EEVOE 303	Basics of Management	3	0	1	VI
16.	Mechanical Engineering (Tool and Die)	METOE301	Non- conventional Energy Systems	3	0	1	V
		METOE302	Energy Management	3	0	1	VI
		METOE304	Fundamental of Mechatronics	3	0	1	VI
17.	Mechanical Engineering (Refrigeration and Air Conditioning)	ME(RAC)OE301	Basics of 3D Printing	3	0	1	V
		ME(RAC)OE302	Quantitative Techniques for Engineers	3	0	1	VI
		ME(RAC)OE304	Solar Thermal Technologies	3	0	1	VI

Note: - “List of Open Electives may be updated according to the advancement in the concerned Course/Technology in the future”.

Course Code	:	ASOE301
Course Title	:	Life Skills for Professional and Personal Life (LSPPL)
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

Life skills prepare students to meet the demands of everyday professional and personal life, besides helping them in appropriately placed. The course aims to develop basic awareness among the students about the significance and useful tips on life skills for their professional growth and facilitate them in developing all-round personality. Hard or technical skills help securing a basic position in one's life and career, whereas, life and soft skills ensure a person retain it, climb further, reach a pinnacle, achieve excellence and derive fulfilment and supreme joy. Life skills comprise of pleasant and appealing personality traits such as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills to name a few. The life skills aims to shape youth's attitudes and beliefs in a positive manner so that they contribute to Self-reliant Bharat (Atamnirbhar Bharat) by making productive life choices and at the same time enable them manage their physical, mental and emotional wellbeing.

The course will enable students:

1. To apply the concepts of self-awareness, self-esteem and self-confidence in their professional and personal lives.
2. To manage their time effectively.
3. To display ethics in their professional and personal lives.
4. To communicate assertively.
5. To build inter-personal communication skills to promote their mental and emotional well-being.
6. To demonstrate positive attitudes and actions for healthy and meaningful social relationships and team working.
7. To live an emotionally healthy life.
8. To demonstrate a balance in their cognitive, physical and social lives, including working in teams.

Unit 1: Life Skills, Soft Skills & Interpersonal Skills:

1. Definition of Life Skills and Soft Skills
2. Significance of Life Skills and Soft Skills in Personal and Professional life
3. Types of Soft skills and Life skills, Ways to develop Soft Skills and Life Skills.
4. Concept of Interpersonal Skills and tips to improve Interpersonal Skills
5. Meaning of Team dynamics and Tips for improving Team dynamics

Unit 2. Communication Skills

1. Meaning of Communication Skills
2. Significance and Characteristics of Assertive Communication,
3. Techniques of Assertive Communication
4. Tips to develop Assertive Communication

Unit 3.Life Skills

(A) Self Awareness:

1. Self Introspection

- (a) Meaning of Self awareness :Introspection, Self Reflection and Insight
- (b) Strategies to improve self awareness
- (c) Importance of counseling and coaching

2. Stress Management

- (a) Meaning of Stress
- (b) Factors causing positive and negative types of stress
- (c) Effects of Stress on mind and body.
- (d) Stress Management techniques

3. Emotional Intelligence:

- (a) Meaning and Significance of EI
- (b) Strategies to develop and enhance Emotional Intelligence

4. Self-Esteem

- (a) Concept, Meaning and Significance of Self-Esteem
- (b) Types of Self-Esteem
- (c) Characteristics of people with High and Low Self -Esteem
- (d) Steps and Tips for improving Self-Esteem

(B) Social Awareness:

1. Meaning and Techniques of social awareness and social skills

2. Empathy:

- (a) Meaning and types of Empathy
- (b) Benefits of Empathy
- (c) Steps for developing Empathy

3. Compassion:

- (a) Meaning and Benefits of Compassion
- (b) Steps to practice Compassion.

4. Body Language:

- (a) Elements of Body Language
- (b) Develop Positive Body language that helps in building positive relationships
- (c) Avoiding Negative Body Language

(C) Thinking Skills:

1. Positive Thinking

- (a) Meaning and Benefits of Positive Thinking
- (b) Tips to develop positive attitude and practice Positive Thinking

(Students can choose any three activities to be written in their Home Assignment

Notebook: 1. Gratitude Journal 2. Preparing your Strength's list. 3. Silver Linings in difficult situations 4. Strengths spotting activity of any four people who inspires and motivates you)

2. Listening Skills:

- (a) Concept, Significance and Process of Listening Skills
- (b) Kinds of Listening
- (c) Factors hindering effective Listening
- (d) Tips for Active and Empathetic Listening

3 Resilience:

- (a) Meaning and Types of Resilience
- (b) Case studies of Resilience

(Students should undertake Minimum Two case studies of Resilience)

Unit 4. Time Management Skills

1. Concept and Significance of Time Management.
2. Benefits of Time Management,
3. Tools and techniques of Time Management
4. How to overcome procrastination and avoid time-wasters

(Student should prepare Daily ‘To-do’ list /Timeboxing to hone up their time management skills . The main wasters should be identified daily and also steps to overcome them. Home Assignment Notebook should be used for these tasks.

Unit 5. Human Values and Ethics

1. Meaning of Human values, Morals and Ethics
2. What is Value and types of values
3. Human Dignity and Humility: Meaning of Human Dignity and Fundamental rights of a person, Meaning of Humility, Significance of humility, Developing and cultivating humility

Course outcomes:

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

CO1	Build and reflect self-confidence and high self-esteem in their behavior and conduct.
CO2	Demonstrate life skills in their professional and personal lives.
CO3	Communicate assertively and make effective presentations.
CO3	Manage time effectively
CO4	Display positive attitude and resilience in their behavior and conduct
CO5	Demonstrate positive interpersonal skills and work effectively in a Team, as a leader and a member.
CO6	Listen actively and empathetically
CO7	Manage adverse circumstances with resilience
CO8	Display emotionally intelligent behavior and create stress free environment
CO9	Demonstrate harmony in their physical, cognitive, personal, social behavior and conduct
CO10	Exhibit and apply social and emotional abilities to climb the ladder of success in personal and professional lives

Reference Books:

1. <https://esoftskills.com/soft-skills-vs-life-skills/#:~:text=Soft%20skills%20primarily%20focus%20on,day%2Dto%2Dday%20living>
2. Soft Skills & Employability Skills. Sabina Pillai&AgnafFernandez.Cambridge UniversityPress.

3. Soft Skills. K. Alex. S. Chand
4. Positivity-Away of life by Manika Ghosh , Published by Orient Blackswan Pvt. Ltd.
5. Clear, J. (2018). Atomic habits: An easy & proven way to build good habits & break bad ones. Penguin.
6. Klaus, Peggy, Jane Rohman & Molly Hamaker. "The Hard Truth about Soft Skills", London: HarperCollins E-books, 2007
7. <https://www.coursera.org/articles/interpersonal-skills>
8. <https://www.indeed.com/career-advice/resumes-cover-letters/interpersonal-skills>
9. <https://www.understood.org/en/articles/4-types-of-social-cues>
10. <https://www.bhf.org.uk/information-support/heart-matters-magazine/wellbeing/how-to-talk-about-health-problems/active-listening>
11. <https://www.scienceofpeople.com/mirroring/>
12. <https://www.apa.org/monitor/2021/11/feature-cultivating-empathy>
13. <https://www.helpguide.org/articles/relationships-communication/empathy.htm>
14. <https://www.verywellmind.com/what-is-compassion-5207366>
15. <https://library.xtensio.com/noise-analysis>
16. <https://hbr.org/2016/06/the-secrets-of-great-teamwork>
17. <https://blog.vantagecircle.com/team-dynamics/>
18. <https://www.indeed.com/career-advice/career-development/how-to-improve-interpersonal-skills>
19. <https://positivepsychology.com/self-awareness-matters-how-you-can-be-more-self-aware/>
20. Peale, Norman Vincent. The Power of Positive Thinking. RHUK, 2016.
21. <https://www.rajeevelt.com/life-skills-teaching-learning-beneficial-holistic-development-child-education/rajeev-ranjan/>
22. https://www.mirecc.va.gov/cihvisn2/Documents/Patient_Education_Handouts/Assertive_Communication_Version_3.pdf
23. <https://positivepsychology.com/assertive-communication/#benefits>
24. <https://www.berkeleywellbeing.com/assertive-communication.html>
25. <https://www.choosingtherapy.com/assertive-communication/>
26. <https://www.executive-impressions.com/blog/why-assertive-communication-important-new-leaders>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted(Hrs)	Marks Allotted(%)
1	13	15
2	09	15
3	26	40
4	8	15
5	8	15
Total	64	100

Course Code	:	ASOE303
Course Title	:	Industrial Water Treatment
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE: At the End of the Chapter Students will be able

- (a) To Understand Water Quality Standard, sources and Classification of pollutants.
- (b) To Understand coagulation-precipitation, neutralization used in chemical treatment technology.
- (c) To Understand membrane based processes used for water treatment.
- (d) To Understand specific treatment used for industrial waste water.
- (e) To Understand the use of modern water treatment technology.

UNIT I

Introduction to water resource management issues, access to safe drinking water, river pollution, water quality standards, sources and classification of pollutants.

UNIT II

Chemical Treatment Technology: aeration, chemical coagulation-precipitation, neutralization, chemical oxidation, adsorption, ion-exchange, And advanced oxidation, disinfection of water

UNIT III

Water treatment by membrane technology: Membrane-based processes, membrane modules, micro, ultra, nano, reverse osmosis, membrane distillation in water treatment. Forward osmosis,

UNIT IV

Industry-specific treatment of water: Coke oven wastewater treatment, Pharmaceutical wastewater treatment, tannery wastewater treatment, petroleum refinery wastewater treatment, pulp and paper industry wastewater treatment

UNIT V

Nanotechnology in water treatment, Hybrid Water Treatment Technologies: Chemical-biological, biological-membrane, membrane-c chemical hybrid treatment technologies in water treatment, sustainable water treatment, ethics, compliance of regulations

Course outcomes:

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

CO1	Learn different sources of energy and basic terminology
CO2	Identify characteristic properties of fuels and analyze fuel processing equipment
CO3	Compare performances and select type of fuel processing equipment

Reference Books:

1. Industrial Water Treatment Process Technology, P. Pal, Elsevier Science
2. Groundwater Arsenic Remediation: Treatment Technology and Scale Up, P.Pal, Elsevier Science

Suggested Reference Books:

1. Wastewater Treatment, Disposal, Reuse, Eddy and Metcalf

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs)	Marks Allotted(%)
1	10	10
2	14	20
3	14	20
4	13	25
5	13	25
Total	64	100

Course Code	:	ASOE302
Course Title	:	Technical Communication
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

This course will help diploma holders to hone up their technical communication skills to enable them enter the technical workforce with greater confidence and desired skill-sets. People who can communicate effectively, using a variety of media, tend to be successful in their professional lives. People with weak communication skills are not able to get appropriate placements, and they generally do not get opportunity to work on challenging projects, which adversely affect their growth and promotions. Technical communication is indispensable for successful any career, whether as an engineer, web developer, programmer or any other professional in technical field. An enhanced awareness about the significance of communication, skills will facilitate an all-round development of personality.

Course Objectives:

The course will enable students to:

1. Use various facets of Technical Communications.
2. Apply different aspects and dimensions of technical writing in the professional settings.
3. Make effective presentations to diverse types of audiences with enhanced confidence.
4. Create and develop a vast know-how of technical communication and its applications at workplace.
5. Bring effectiveness in situations like problem-solving, resolving conflicts and team-working etc.
6. Speak flawlessly and with confidence.
7. To handle a variety of social and business situations and display professional behavior.

DETAILED CONTENTS

Unit 1: Fundamentals of Technical Communication

1. Language as a tool of Communication
2. Features of Technical Communication
3. Distinction between General and Technical Communication
4. Channels of Communication at workplace: Downward, Upward, Lateral or Horizontal, Diagonal, Grapevine, Consensus
5. Barriers to Communication and overcoming barriers

Unit 2. Technical Writing

1. Types of Technical writing
2. Drafting skills: Agenda and Minutes of Meetings, Official and Business Correspondence
3. Different formats of Report writing
4. Basics of Grammar: Spotting errors in sentences (Noun, Pronoun, Verb, Adverb, Adjective, Preposition, Conjunction, Article, Modals, Tenses, Punctuation)
5. Resume Writing and Covering letter

(Students should prepare a Resume and a Covering letter as part of Home Assignment)

Unit 3. Presentation Skills

1. Concept and Significance of Presentation skills
2. Steps of a Effective Presentation
3. Elements of Effective Presentation skills, including public speaking Clarity of substance; Emotion, Humour, Overcoming Fear, Confident speaking, Audience Analysis and Retention of audience interest
4. How to improve Presentation Skills

Unit 4. Speaking skills

1. What are Speaking Skills and Characteristics of a Good Speech
2. What is Panel Discussion and its procedure
3. Job Interview Skills: What to do Before, After and During Interview
4. Body Language Examples and their Meanings-Positive and Negative. Body language for interviews
5. Difference between Etiquettes and Manners ,Table Etiquettes , Business Etiquettes, Telephone Etiquettes, Dressing Etiquettes and Workplace Etiquettes, How to get along with opposite Gender
6. What are the elements of Voice Modulation (Quality, Pitch, Rhythm, Volume, Pace; Intonation; Pronunciation; Articulation; stress & accent);Tips for better Voice modulation

(Mock Interview should be undertaken in collaboration with subject experts from respective branches to give students practical exposure of facing an interview.)

Course Outcomes

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

CO1	Adapt, accept and adjust to the physical and emotional changes in one's own self and influence others positively.
CO2	Classify the correct usage of English grammar in writing and speaking.
CO3	Develop various written communication strategies of resume writing and official correspondence
CO4	Demonstrate the use of verbal and non-verbal communication in academic and non-academic platforms.
CO5	Demonstrate appropriate communication behavior to enhance self-representation and interpersonal skills through pleasing manners and charming personality

Reference Books:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta

- Sharma, Oxford Univ. Press, 2007, New Delhi.
2. <https://www.skillsyouneed.com/quiz/343479>
 3. <https://www.indeed.com/career-advice/career-development/project-management-report>
 4. <https://whatfix.com/blog/technical-writing-examples/>
 5. <https://virtualspeech.com/blog/technical-presentation>
 6. Csikszentmihalyi, Mihaly. Flow: The Psychology of Optimal Experience. Harper Perennial Modern Classics, 2018.
 7. Canfield, Jack et al. Chicken Soup for the Unsinkable Soul, Backlist LLC, 2012.
 8. <https://www.sussex.ac.uk/ei/internal/forstudents/engineeringdesign/studyguides/techreportwriting>

SUGGESTED DISTRIBUTION OF MARKS:

Topic No.	Time Allotted(Hrs)	Marks Allotted(%)
1	14	20
2	25	40
3	10	15
4	15	25
Total	64	100

Course Code	:	ASOE304
Course Title	:	Composites Science &Technology
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

Why use composites? The greatest advantage of composite materials is strength and stiffness combined with lightness. By choosing an appropriate combination of reinforcement and matrix material, manufacturers can produce properties that exactly fit the requirements for a particular structure for a particular purpose

1. Introduction:

Definition – Classification and characteristics of Composite materials. terminology used in fiber science, Advantages and application of composites. Introduction to composite materials: General characteristics of reinforcement- classification.

2 Polymer matrix composites:

Thermoplastic and thermosetting resins; Commonly used matrix reinforcement system; Fibre, Flake and particulate reinforced composites, Reinforcements used in PMC's- glass, carbon, aramids, boron, Roving's, yarns, fabrics, etc.; Thermoset matrices for aerospace components- polyesters, epoxies, phenolics, vinyl esters, cyanate esters, etc.;

3 Specialty composites:

Composites for satellites and advanced launch vehicles, Design considerations PMC- for structural composites, Silicon carbide composites, design, processing and properties Carbon-Carbon composites: Matrix precursors, Manufacturing considerations, Nanocomposites: Nano particle dispersion in polymer matrix, Polymer- nanoclay composites and polymer-carbon nanotubes composites.

4 Manufacturing techniques:

Hand lay-up, Filament winding, Pultrusion, Resin transfer molding, Processing science of reactive polymer composites, Process steps for production, Selection of processing conditions toolings, Equipments, Carbon-carbon composites, Processing, Thermal and mechanical properties, Quality control.

5 Testing of composites:

Raw material testing, Property evaluation at laminate level, NDT techniques.

Course outcomes:

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

CO1	Explain the advantages and applications of composite materials.
CO2	Describe the properties of various reinforcements of composite materials.
CO3	Summarize the manufacture and application of speciality composites.

Reference Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007. References: 1. Hand Book of Composite Materials-ed-Lubin. 2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	20
2	15	25
3	12	20
4	15	25
5	8	10
Total	64	100

AROE301-Vastu-Shastra

Teaching Schedule			Marks of Sessional work	Marks of Examination		Total marks	Credits	Duration of Examination (h)
L	P	DCS		Theory	Practical			
3	-	1	40	60	-	100	3	3

COURSE OBJECTIVE:

1. To know about various theories related to building design based on Vastu Shastra.
2. To acquaint with various principles and concepts of Design based on Vaastu Shastra.

UNIT	COURSE CONTENT
I	<p>General: -</p> <p>Various Directions and their importance and uses along with the various terms used to refer these directions in Vaastu Shastra</p> <p>Various effects of Vastu Shastra in buildings or towns along with suitable examples.</p> <p>Position of the various usable spaces like, drawing hall, kitchen, master bed room, children bed, guest bed room, store, pooja room, dining hall, car porch etc in a residential building</p> <p>Location of septic tank, water source/ overhead water tanks, main entrance gate, Electric meter etc in a residential building.</p> <p>Vastu based planning of the individual rooms in a residential building, shapes of doors and windows and other openings in a residential building.</p> <p>Use of the various colours with reference to the different directions as per Vastu Shastra. Remedies as per Vastu Shastra in existing Buildings not designed as per Vastu Shastra.</p>
II	<p>Site Selection & Approach Roads</p> <p>Shapes of various plots and their good or ill effects as per Vastu Shastra.</p> <p>Position of various approach road around a plot and their effects as per Vastu Shastra, Most suitable access road as per Vastu shastra, Access roads to be avoided as per vastu Shastra</p> <p>Planning and positioning of the main entrance gate of the various plots facing South, West, East, North, NE, SE, SW & NW.</p>
III	<p>General Guidelines and Principles to be followed in planning of a residential building following Vastu Shastra tips</p> <p>A three bed room house planning considering all the important concepts and principles of Vastu Shastra based planning like position of various rooms in a residential building, main entrance, location of septic tank and soak pit and other important spaces of a residential building.</p>

COURSE OUTCOMES

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

- i. The various aspects of Vastu Shastra which are in practice and are beneficial to the society.
- ii. The basic techniques of Vastu Shastra to make people healthy and happy by using the Vastu tips.
- iii. The problem solving related to ill effects of existing buildings.

BOOKS AND REFERENCES

1. The Journey of Vastu Shastra: Lets have More Money, Happiness and Growth in LifeBy: - Abhishek Goel.
2. Ancient Science of Vastu By:- Vishwakarma Prakash.
3. The Miracles of Vastu shastra By:- Shanku Shiva Dass.
4. Vastu Shastra in modern Context By:- Anand Bhardwaj.
5. The need of Vastu Shastra By:- Pratul Chanra Dass.

NOTE:

- A site visit may be arranged for the students to develop a real time problem solving approach w.r.t. Vastu Shastra.
- Students may develop the plans of a residential building based on the concept of Vastu Shastra.

Suggested Distribution of Marks		
Unit	Time Allotted(Hrs)	Marks Allotted (%)
I	32	50
II	16	25
III	16	25
TOTAL	64	100

AROE302-Architecture Photography

Teaching Schedule			Marks of Sessional work	Marks of Examination		Total marks	Credits	Duration of Examination(h)
L	P	DCS		Theory	Practical			
3	-	1	40	60	-	100	3	3

COURSE OBJECTIVES:

1. To familiarize students with the basic skills of photography for use in architecture, landscape design, interior design both as a tool of documentation and aesthetic interpretation.
2. To develop understanding about the photography equipment and its uses.

UNIT	COURSE CONTENT
I	Nature, history and scope of photography. Various applications of photography. Creative composition in photography. Architectural photography and its role in documentation and creative design process (Basic introduction to the principles of design)
II	General introduction to the art of photography; concept of color; concepts of lighting, distance, visual angle, Frames; media.
III	UNDERSTANDING THE TOOLS Various types of cameras and films. Components of SLR, DSLR and Mirror less Cameras. Various types of lenses i.e. Macro, Wide angle, portrait and telephoto lenses for full frame and crop sensor cameras and their uses/applications. Other camera accessories.
IV	CREATING EXPRESSION Field assignments in groups of photography, interior and landscape photography work - both in color and black and white mediums. To document and interpret as aesthetic expression - various subjects of photography such as buildings, landscapes and interiors Basic introduction to the photo editing software like Photoshop, light room etc.

COURSE OUTCOMES

Upon successful completion of the course, the students will be able to

- i. Understand the basics of photography.
- ii. Understand the basic skills of photography for use in architecture, and related fields like, landscape design interior design both as a tool of documentation and aesthetic interpretation.
- iii. Develop a flair for creativity and aesthetics.

BOOKS AND REFERENCES

1. Architectural Photography, 1976

2. Photographers equipment book, 1984 by Brusselle Michael
3. Architectural Photography by Michael G. Harris

NOTE:

- Detailed teaching program to be made and circulated to the students at the commencement of the semester.
- Photography lab shall be setup comprising of the latest cameras and lenses mentioned above.
- Study Tour/Visit shall be arranged by the subject teacher of any nearby project for practical exposure of photography.

Suggested Distribution of Marks		
Unit	Time Allotted (Hrs.)	Marks Allotted (%)
I	18	30
II	12	15
III	18	30
IV	16	25
Total	64	100

AROE304-Sustainable Development

Teaching Schedule			Marks of Sessional work	Marks of Examination		Total marks	Credits	Duration of Examination (h)
L	P	DCS		Theory	Practical			
3	-	1	40	60	-	100	3	3

COURSE OBJECTIVE:

1. Understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.
2. Know the history of the Sustainable Development idea.

UNIT	COURSE CONTENT
I	Introduction to Sustainable Development: Glimpse into History and Current practices - Broad introduction to SD - its importance, need, impact and implications; definition coined; evolution of SD perspectives (MDGs AND SDGs) over the years; recent debates; 1987 Brundtland Commission and outcome; later UN summits (Rio summit, etc.) and outcome.
II	Ecosystem & Sustainability: Fundamentals of ecology - types of ecosystems & interrelationships, factors influencing sustainability of ecosystems, ecosystem restoration - developmental needs. Introduction to sustainability & its factors, requirements for sustainability: food security and agriculture, renewable resources - water and energy, non-renewable resources, factors and trade-offs, sustainability conflicts, a conceptual framework for linking sustainability and sustainable development.
III	Gauging Sustainable Development - Sustainability and development indicators and SDGs, UN's outlook of sustainable development and efforts, UN SDGs - structure, governance and partnerships; communities / society: ensuring resilience and primary needs in society; biosphere: development within planetary boundaries; strengthening institutions for sustainability; shaping a sustainable economy.
IV	Case Studies & Projects on Rural Sustainable Development (Indian village perspectives) - Village resources (broad perspectives); current challenges and thematic areas; village social hierarchy; village economy; needs of present and future generation; conflicts - sustainability and rural culture & tradition; road to achieving sustainable development goals - bridging conflicts and way forward

COURSE OUTCOMES

Upon completion of the course students will be able to:

- i. Understand the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions.
- ii. Understand the embedment of sustainability issues in environmental, societal, and economic systems, and the relevance of the conditions, interrelations, and dynamics of

- these systems.
- iii. Get sensitise and aware about the dire need of sustainability in the contemporary world.

BOOKS AND REFERENCES

- 1. Sustainable Building, Design Manual –Vol-1,2. – TERI Press.**
- 2. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>**

NOTE:

- A site visit may be arranged for the students to understand the concerns of sustainable development w.r.t to rural environment.

Suggested Distribution of Marks		
Unit	Time Allotted(Hrs)	Marks Allotted (%)
I	8	10
II	14	20
III	24	40
IV	18	30
TOTAL	64	100

Course Code	:	AEOE 301
Course Title	:	Vehicular Systems
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To introduce internal combustion engine
- To explain different components of internal combustion engine
- To explain working of different parts of transmission system
- To describe construction of different automotive chassis components
- To analyse braking systems of automobiles.

Course Content:

Unit I Introduction

Types of automobiles, different layouts of vehicle, chassis, frame and body, Spark Ignition (SI) & Compression Ignition (CI) engines.

Unit II Automotive Engine Parts

Cylinder – arrangements and their relatives merits, Liners, Piston, connecting rod, crankshaft, valves, valve actuating mechanisms.

Unit III Transmission Systems

Clutch-types and construction of single plate clutch, propeller shaft, slip joints, universal joints, Differential, and rear axle.

Unit IV Brakes and Suspension Systems

Requirements, leaf spring, coil spring. Types of brakes, mechanical and hydraulic braking systems, brake shoe arrangements, Disk brakes, drum brakes, Antilock –Braking systems, purpose and operation of antilock-braking system.

Unit V Safety and Comfort Systems

Passive Safety Systems – Airbags, Seatbelts, Crumple Zones, Active Safety Systems – Automatic Driver Assist Systems (ADAS), Antilock Braking System, Reverse parking system, Anti-collision system, Traction control system, Comfort Systems – Cruise control system, Heating, ventilation and Air-conditioning system (HVAC), Autonomous Driving Cars – Level of Driving Automation.(Basic definitions and functions only)

Text books:

1. Automobile Engineering-R. B. Gupta, Satya Prakashan.
2. Automobile engineering-Kirpal Singh. Vol I and II.

References:

1. Ganesan V, "Internal Combustion Engines", Tata McGraw Hill Book Co.
2. Ehsani, M, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005

4. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric,
5. Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
6. Bosch “Automotive Handbook”, Robert Bosch GmbH, Germany, 2008, Eighthth Edition.

Course Outcomes: At the end of the course the student should be able to:

CO1	Distinguish the different types of automobiles and chassis.
CO2	Interpret the various types of engines.
CO3	Select the appropriate transmission systems.
CO4	Compare the braking and suspension systems.
CO5	To have information about various safety systems.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	11	20
2	14	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	AEOE 302
Course Title	:	Automotive Pollution and Control
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To describe emissions from SI and CI engines, measure and control the same.
- To identify sources of noise, measure and control the same.
- To enumerate emission control techniques.

Course Content:

Unit I: Emissions from SI and CI Engines: Emission formation in SI and CI engines – factors influencing emission, effect of pollution on environment and human health.

Unit II: Emission Testing: Emission test cycles, constant volume sampling method, non-dispersive infrared (NDIR) analyzer, flame ionization detectors (FID), chemical luminescence analyzer, smoke meters, and gas chromatograph.

Unit III: Emission Control Techniques: Air fuel ratio (A/F) control, crank case emission control, fuel evaporation & control, EGR, SCR, catalytic converters, Particulate traps. Effect of engine combustion on human body, engine modification and emission technologies.

Unit IV: Noise and Noise Control: Introduction to sound, noise measurements, control of air borne and structure borne noise- use of absorber, criteria for the selection of materials.

Unit V: Emission Norms: Emission norms - Euro & Bharat norms, effect of fuel properties and additives, emissions from alternate fuels.

Text Books:

1. Pundir B P, “Engine Emissions: Fundamentals and Advances in Control”, Alpha Science International Ltd, 2017.
2. Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Matthew Harrison, Butterworth-Heinemann, Burlington, 2011.
3. XuWang ,“Vehicle Noise and Vibration Refinement”, Woodhead Publishing; 1st edition, 2010.

References:

1. James D. Halderman, “Automotive Fuel and Emissions Control Systems”, 4th Edition, Prentice Hall, Pearson Education, 2016.
2. Gang Sheng, “Vehicle Noise, vibration and Sound quality”, SAE International 2012.

Course Outcomes: At the end of the course the student should be able to:

CO1	Identify the sources of vehicle emission, properties of various types of fuel and additives in control of emission.
CO2	Apply the emission standard test methods and procedure in accordance to driving conditions for different vehicles.
CO3	Evaluate different pre-combustion and post combustion methods involving in emission control.
CO4	Understand the sources of vehicle noise in vehicle refinement along with control measures.
CO5	Understand the emission norms.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	11	20
2	14	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	AEOE 304
Course Title	:	Vehicle Body Engineering
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand different types of chassis.
- To gain knowledge about different types of vehicle body.
- To understand ergonomics of an automobile.
- To describe the various materials used in vehicle body engineering.
- To understand the painting process in Automobiles.

Detailed Contents:

Unit – I: Introduction: Classification of automobiles on different basis, Types of vehicle bodies, requirements of automobile body, constructional details.

Unit – II: Car body details: Types: Saloon, hatchback, convertibles, Limousine, Estate Van, racing and sports car, etc. Carbody construction types – frame and unitary, various body panels and their constructional details.

Unit- III: Bus body details: Types: Mini bus, single and double Decker, split level and articulated bus, Bus body lay out, Floor height, Engine location, Entrance and exit location, Seating dimensions, Constructional details: Frame construction, Types of metal section used, Conventional and integral type construction.

Unit - IV: Commercial vehicle details: Types of commercial vehicles. Commercial vehicle body details, flat platform, drop side, fixed side, tipper body, tanker body, tractor trailer.

Unit- V: Body materials, trim and mechanisms: Carbon fibers, plastics, timber, GRP; ferrous and non-ferrous materials used in vehicle. Corrosion and anticorrosion methods. Paint and painting process, Corrosion, Anticorrosion methods, Body trim items, Body mechanisms.

Course Outcomes: At the end of the course the student should be able to:

CO1	Understand the fundamentals of various automotive body construction details
CO2	Identify different aspects of car body and bus body, types, commercial vehicle.
CO3	Describe the materials used in body building, tools used, body repairs
CO4	Analyse vehicle body for different load conditions
CO5	Understand various body designs according to load.

Suggested Readings/Books:

1. J Powloski, "Vehicle Body Engineering", Business Books Ltd., London.
2. Kirpal Singh, "Automobile Engineering Vol-1", Standard Publishers distributors
3. Braithwaite J.B., "Vehicle Body building and drawing ", Heinemann Educational Books Ltd., London.
4. Sydney F. Page "Body Engineering" Chapman & Hill Ltd., London,
5. John Fenton, "Handbook of Automotive Body and Systems Design", Wiley.
6. Heinz Hezler "Advance vehicle Technology"

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	11	20
2	14	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	CEOE301
Course Title	:	Project Management
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

- To develop the idea of project plan, from defining and confirming the project goals and objectives,
- Identifying tasks and how goals will be achieved.
- To develop an understanding of key project management skills and strategies.

Course Content:

UNIT-I: Concept of a project:

Classification of projects- importance of project management. The project life cycle- establishing project priorities (scope-cost-time) project priority matrix- work break down structure.

UNIT-II: Capital budgeting process:

Planning Analysis- Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: Financial estimates and projections:

Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: 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. Non-financial justification of projects.

UNIT-V: Project administration:

Progress payments, 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. Determination of least cost duration. Post project evaluation.

Suggested Learning Resources

- Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
- Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson – McGraw Hill

- Project management - David I Cleland - McGraw Hill International Edition, 1999
- Project Management – Gopala Krishnan – McMillan India Ltd.
- Project Management-Harry-Maylor-Pearson Publication

Course outcomes:

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

- Understand the importance of projects and its phases.
- Analyze projects from marketing, operational and financial perspectives.
- Evaluate projects based on discount and non-discount methods.
- Develop network diagrams for planning and execution of a given project.
- Apply crashing procedures for time and cost optimization.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	12	20
2	13	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	:	CEOE 302
Course Title	:	Engineering Geology
Number of Credits	:	3(L:3, P: 0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

The course should enable the students to:

- Understand the origin and formation of earth and various geological processes.
- Learn about types of rocks and minerals.
- Acquire knowledge of various terminologies in structural geology.
- Know about various methods of geological investigations.

Unit I: Introduction.

- Introduction and branches of Geology,
- Importance of Engineering Geology,
- Scope of engineering geology: Geology in construction jobs, Geology in water resource development, Geology in town and regional planning.

Unit II: The Earth

- A brief account of theory of origin of Earth. Size, Shape, mass, density and atmosphere of Earth.
- Internal structure and chemical composition of Earth.

Unit II: General Geology

- Geological work of atmosphere (rock Weathering) types and effect.
- Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition. Resulting Features and Importance in Engineering.

Unit III: Study of rocks

- Types of rocks (Igneous, Sedimentary & Metamorphic rocks): Their composition and engineering importance.
- Engineering properties of rocks as material for construction: building stones, properties and important building stones.
- Building stone as road material, quality of aggregate, common road aggregate.

Unit IV: Structural Geology

- Dip and strike, apparent dip and true dip.
- Folds, elements of fold, types of fold, causes of folding.
- Fault terminology, classification of faults. Significance of faults.

Unit V: Geological investigations

- Introduction and objective of geological investigations
- Methods of geological investigations,
- Geophysical investigations, Seismic method of investigation, Gravitational method, Acoustic methods.

References:

- K.M Bangar, Standard Publishers Distributors.

- Prabin Singh, Katson Books.
- G.B Mahapatra, CBS Publishers & Distributors
- Dr. D S Arora M C Publishers

Course Outcomes:

After completing this course, student will be able to:

- Recognize the fundamentals of the Earth, earth's dynamic actions and their importance.
- Identify and classify rocks and minerals.
- Describe types and processes of weathering and erosion and other geological processes.
- Understand Structural Geology.
- Know about various methods of geological investigations

Topic NO.	Time Allotted (Hrs.)	Marks Allotted (%)
UNIT-I	12	20
UNIT-II	13	20
UNIT-III	13	20
UNIT-IV	13	20
UNIT-V	13	20
Total	64	100

Course Code	:	CEOE304
Course Title	:	Disaster Management
Number of Credits	:	3(L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

Following are the objectives of this course:

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organizations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

Course Content:

Unit – I: Understanding Disaster

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity

– Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters

- Geological Disasters (earthquakes, landslides, tsunami, mining);
- Hydro-Meteorological Disasters (Floods, cyclones, lightning, thunderstorms, hailstorms, avalanches, droughts, cold and heat waves)
- Biological Disasters (epidemics, pest attacks, forest fire);
- Technological Disasters (chemical, industrial, radiological, nuclear) and
- Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters)
- Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit- III: Disaster Management Cycle and Framework

- Disaster Management Cycle – Paradigm Shift in Disaster Management.
- Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation, and Micro zonation,
- Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development.
- Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency
- Operation Centre – Incident Command System – Relief and Rehabilitation
- Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early
- Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

Unit– IV: Disaster Management in India

- Disaster Profile of India – Mega Disasters of India and Lessons Learnt.
- Disaster Management Act 2005 – Institutional and Financial Mechanism,
- National Policy on Disaster Management, National Guidelines and Plans on Disaster Management.
- Role of Government (local, state, and national), Non-Government and Inter Governmental Agencies.

Unit– V: Applications of Science and Technology for Disaster Management

- Geo-informatics in Disaster Management (RS, GIS, GPS, and RS).
- Disaster Communication System (Early Warning and Its Dissemination).
- Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions,
- Structural and Non-Structural Mitigation of Disasters
- S&T Institutions for Disaster Management in India

Suggested Learning Resources

- Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
- Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
- Alexander, David, Natural Disasters, Kluwer Academic London
- Ghosh, G. K., Disaster Management, A P H Publishing Corporation
- Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

Course Outcomes:

After completing this course, student will be:

- Acquainted with basic information on various types of disasters
- Knowing the precautions and awareness regarding various disasters
- Decide first action to be taken under various disasters
- Familiarized with organization in India which are dealing with disasters
- Able to select IT tools to help in disaster management.

Suggested Distribution of Marks		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	8	12
2	16	24
3	16	24
4	12	20
5	12	20
Total	64	100

Course Code	:	COOE301
Course Title	:	Introduction to e - Governance
Number of Credits	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

To cover the concepts of e-Governance and to understand how technologies and business models shape the contours of government for improving citizen services and bringing in transparency.

Course Outcomes:

After the completion of the course learners will be able to:

CO 1	Understand the different models of E-governance.
CO 2	Describe the e-governance projects at Union and State Govt. level.
CO 3	Understand the benefits and reasons for the introduction of e-governance at the local level.
CO 4	Realize the issues and challenges of e-governance.

DETAILED CONTENTS

UNIT 1: 12 Hours

Exposure to emerging trends in ICT for development; Understanding of design and implementation of e-Government projects, e-governance lifecycle.

UNIT 2:12 Hours

Need for Government Process Re-engineering (GPR); National e-Governance Plan(NeGP) for India; SMART Governments & Thumb Rules

UNIT 3:16 Hours

Architecture and models of e-Governance, including Public Private Partnership (PPP); Need for Innovation and Change Management in eGovernance; Critical Success Factors; Major issue including corruption, resistance for change, e-Security and Cyber laws

UNIT 4:16 Hours

Focusing on Indian initiatives and their impact on citizens; Sharing of case studies to highlight best practices in managing e-Governance projects in Indian context. Visits to local e-governance sites(CSC, eSeva, Post Office, Passport Seva Kendra, etc) as part of Tutorials.

UNIT 5:8 Hours

Mini Projects by students in groups – primarily evaluation of various e-governance project

Reference Books:

1. Managing Transformation –Objectives to Outcomes. J Satyanarayana, Prentice Hall India
2. The State, IT and Development. Kenneth Kenniston, RK Bagga and Rohit Raj Mathur, Sage Publications India Pvt Ltd.
3. e-Government -The Science of the Possible. J Satyanarayana, Prentice Hall, India
4. <http://www.csi-sigegov.org/publications.php>
5. <https://negd.gov.in>
6. <https://www.nisg.org/case-studies-on-e-governance-in-india>

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	18
2	12	18
3	16	25
4	16	25
5	8	14
Total	64	100

Course Code	: COOE302
Course Title	: Introduction to E-Commerce
Number of Credits	: 3 (L:3; DCS:1; P:0)
Prerequisites	: NIL
Course Category	: Open Elective

Course Learning Objectives:

The course introduces students to the basic concepts and evolution of e-commerce, including its advantages, challenges, and impact on traditional business models. This includes the detailed study of various e-commerce business models, such as B2C (Business-to-Consumer), B2B (Business-to-Business), C2C (Consumer-to-Consumer), and others. This course will equip students with the knowledge and skills needed to navigate the dynamic and ever-changing landscape of online business effectively.

Course Outcomes:

After the completion of the course learners will be able to:

CO 1	Understand the concept of E-commerce
CO 2	Analyze various E-commerce business models
CO 3	Categorize advantages and disadvantages of different online payment options
CO 4	Assess e-commerce strategies and applications

COURSE CONTENTS

UNIT-I: Introduction to E-Commerce.....14 Hours

An Overview of Electronic Commerce, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Cyber Laws. E-Commerce Technologies: Different types of Networking for E–Commerce, Internet, Intranet & Extranet, EDI Systems. WAP, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement for E – Commerce.

UNIT-II: Business Models of E – Commerce..... 14 Hours

Business Models of e –commerce: Model Based on transaction type, Model Based on Transaction Party - B2B, B2C, C2B, C2C, E – Governance.

UNIT-III: Electronic Data Interchange..... 12 Hours

Electronic Data Interchange (EDI): Benefits, EDI working concepts, Applications, EDI Model, Protocols (UN EDI FACT Data Encryption (DES / RSA), EDI implementation difficulties.

UNIT-IV: Electronic Payment Systems..... 12 Hours

Electronic Payment Systems, Electronic Cash, Smart Cards and Electronic Payment Systems, Credit Card Based Electronic Payment Systems, Risks in Electronic Payment Systems.

UNIT-V: Security issues in E – Commerce..... 12 Hours

Risk in E – Commerce, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Reference Books:

1. Bhaskar Bharat: Electronic Commerce - Technologies & Applications. TMH
2. E – Commerce: Strategy Technologies & Applications, Tata McGraw Hill.
3. Murthy: E – Commerce, Himalaya Publishing.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	25
2	14	25
3	12	18
4	12	18
5	12	14
Total	64	100

Course Code	:	COOE304
Course Title	:	Computer Hardware and Peripherals
Number of Credits	:	3 (L:3; DCS:1; P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives:

This course is designed to acquaint students with knowledge of computer hardware, peripherals and networking devices. After completing this course, the students will be able to identify various hardware devices, prepare the specification of required computer hardware for home / office use and perform basic troubleshooting.

Course Outcomes:

After the completion of the course learners will be able to:

CO 1	Identify and understand various hardware and network devices.
CO 2	Understand different internet connectivity technologies.
CO 3	Identify different hardware/networking faults and their possible solutions.

Course Contents

UNIT-I Computer Hardware Devices 14 Hours

PC components, Processor types and their features, Processor specification, Overview of motherboards, Bus system –data I/O bus, Address bus, Internal Data bus, Comparing processor performance, BIOS, BIOS setup menus, Limitation of BIOS, UEFI, overview of Mobile devices hardware.

UNIT-II Input/ Output Devices and Memory20 Hours

Objective of I/O Devices, Types of input devices, Different printing devices and their use, Display types– LCD, LED, Plasma, OLED, HDTV, Data projector; Video connector types – VGA, DVI, HDMI, S-Video Characteristics of display devices – Resolution, refresh rate, response time, color quality, USB port. Memory basics –ROM, RAM, Types of RAM, Memory Module –Registered Modules, SDR DIMM, DDR DIMM, DDR2 DIMM, DDR3 DIMM, DDR4 DIMM, Concept of cache –internal cache, External Cache (L1, L2, L3 cache).

UNIT-III Storage Devices14 Hours

Type of storage devices, Benefits and features of storage devices, Principle and operation of HDD, Basic HDD components, HDD cables and connectors, Optical Storage –CD/DVD construction technology, DVD format and standards, Concept of HD-DVD, Optical drive performance specifications –data transfer rate, drive speed, access time; Flash and removable devices –USB flash drive, SSD, Flash card readers; Concept of cloud-based storage.

UNIT-IV Networking Devices16 Hours

Different types of networking devices –NIC, Repeaters, Switch, Hub, router, gateways, bridge, modem, Access point, Bluetooth, Firewall. Internet connectivity technologies –Dial-up, ISDN, broadband, Wi-Max, leased line, Networking cables and their comparison, Networking tools.

Reference Books:

1. CompTIA A+ Certification Guide, Mark Edward Soper et al., Pearson Publisher.
2. The Complete PC Upgrade and Maintenance Guide, Mark Minasi, John Willey & Sons Inc.
3. Upgrading and Repairing PCs, Scott Mueller, Que Publication

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	14	20
2	20	35
3	14	20
4	16	25
Total	64	100

Course Code	:	EEOE301
Course Title	:	Illumination Practices
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

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

- Design illumination schemes and associated electrification of buildings.

Course contents:

Unit – I Fundamentals of illumination

Basic illumination, Terminology, Laws of illumination, Polar curves (definition only), Measurement of illumination Lighting calculation methods (brief introduction only)

Unit – II Types of lamps

Incandescent lamp, ARC lamps – AC and DC arc lamps, Fluorescent lamp.

Types of other lamps: Mercury vapour lamp, HPMV lamp, Mercury iodide lamp, Sodium vapour lamp, Halogen Lamps, Ultraviolet Lamps, Neon Lamps, Neon Sign Tubes. Metal halides, HID and Arc lamps, LED lamps, CFL, Lasers.

Selection Criteria for lamps.

Unit– III Illumination Control and Dimmer Circuits

Purpose of lighting control and Dimmer circuits.

Working principle and operation of Dimmer circuits.

Transformer and their types, Dimmer Transformer, Auto transformer dimmer, two winding transformer dimmer

Electronic Dimmer: Brief introduction and applications (only).

Unit– IV Illumination for Interior Applications

Standard for various locations of Interior Illumination.

Design considerations for interior location of residences, Commercial & Industrial premises. Illumination schemes for different interior locations of Residential, Commercial & industrial unit.

Unit– V Illumination for Interior Applications

Factory Lighting, Street Lighting (Latest Technology), Flood Lighting, Railway Lighting, Agriculture and Horticulture lighting, Health Care Centres / Hospitals, Decorating Purposes, Stage Lighting.

References:

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
4. Butterworths, Lyons Stanley, Handbook of Industrial Lighting, Butterworths
5. Simpson Robert S, Lighting Control Technology and Applications, Focal Press
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above mentioned competency:

- a) Select relevant lamps for various applications considering illumination levels
- b) Select the lighting accessories required for selected wiring scheme.
- c) Design relevant illumination schemes for interior applications.
- d) Design Illumination schemes for various applications
- e) Design Illumination schemes for various outdoor applications.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	12	10
3	14	14
4	14	14
5	12	12
Total	64	60

Course Code	:	EEOE302
Course Title	:	Energy Efficiency And Audit
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning 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 Contents:

Unit – I Introduction to Energy Efficiency

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

Unit – II Pumping Systems, Fans and Blowers

Factors affecting pump performance; Efficient Pumping system operation; Energy conservation opportunities in Pumping systems; Energy Conservation opportunities in Fan and blowers, Tips for energy saving in fans and blowers.

Unit –III 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– IV Energy Efficient Electrical Machines

Need for energy conservation in induction motor and transformer, Energy efficient motor; significant features, advantages and Limitations.

Energy efficient transformers, amorphous core transformers; epoxy Resin cast transformer/Dry type of transformer, Technical losses; causes and measure to reduce losses, Commercial losses: pilferage, causes and remedies.

Unit– V 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.

Reference Books:

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., Venkateshaiah; 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 and Co. New Delhi, 2016, ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K Kataria and Sons, New Delhi ISBN-13: 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

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Undertake energy efficiency activities
- Use energy efficient pumps, compressors and blowers
- Use energy efficient Air Compressors and DG sets
- Use energy efficient Lighting Systems
- Apply energy efficient electrical machines.
- Use Co-generation and relevant tariff for reducing losses in facilities.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Alloted (Hrs)	Marks Allotted
1	12	10
2	12	10
3	14	14
4	14	14
5	12	12
Total	64	60

Course Code	:	EEOE304
Course Title	:	Electric Traction
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

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

- ❖ Maintain electric traction systems.

Course contents:

Unit – I Basics of Traction

General description of Electrical Traction system in India.

Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive

Problems associated with AC traction System and remedies for it.

Unit – II Power Supply Arrangements

Constituents of supply system: -

Substation: layout, list of equipment and their functions

Feeding post: list of equipment and their functions

Brief introduction to - Feeding and sectioning Arrangements, Sectioning and paralleling post, Sub sectioning and Paralleling post, Sub sectioning post, Elementary section.

Unit– III Overhead Equipment

Different types of overhead equipments

Different types of OHE Centenary Construction.

OHE Supporting Structure, Cantilever assembly diagram

Brief introduction to - Trolley collector, Bow collector, Pantograph Collector

Brief introduction to pantograph.

Unit– IV Electric Locomotive

Classification and Nomenclature of Electric Locomotive

Block diagram of AC locomotive

Power Circuit of AC Locomotive

Unit– V Traction Motors and Train Lighting

Desirable characteristics of traction motor.

Types of motors used for traction with their characteristics and features

Control of motors used for traction and methods to control

Requirements of braking, brief introduction to different types of braking

References:

1. G.C. Garg, Utilization of Electric Power & Electric Traction, Khanna Book

- Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018
2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
 3. Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
 4. Partab H., Dhanpat Rai and Co, Modern Electric Traction

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- a) Interpret the traction layout and its systems
- b) Maintain the power supply arrangements.
- c) Maintain the function of the overhead equipment for electric traction

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	12	10
3	14	14
4	14	12
5	12	14
Total	64	60

Course Code	:	EEEEOE301
Course Title	:	Powering Building : Strategies for Electrification
Number of Credits	:	3 (L:3, T:0, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course objectives:

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

- Design electrical installation systems in building complexes.

Course contents:

Unit-1: Electrical Safety & Prevention Techniques

Definition of Safety, Hazard, accident, major accident hazard, responsibility, authority, accountability, Monitoring. Need of Safety, I.E. Rules & Statutory regulations for safety of persons & equipment in electrical installation, causes of electrical accidents, severity of shock, Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration, Precautions to be taken to avoid fire due to electrical faults, various measures to prevent electrical accidents, types and operation of fire extinguishers.

Unit – II: Electrical Wiring Components & Accessories

PVC Cable: Constructional features, types, and rating of PVC wiring.

Classification of switches according to working such as single pole, double pole, two-way, two-way centre off, intermediate, series parallel switch.

Types of different switches such as surface switch, flush switch, and pull switch, rotary switch etc. Various types of holders and their utilization

Types of sockets like two pin, three-pin, multi pin sockets, two-pin and three-pin plug.

Accessories such as Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber, Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes. Modular accessories.

Classification of electrical accessories- controlling, holding, safety, outlet, BIS symbols of following electrical accessories.

Unit-III: Electrical Power Protection Components & Accessories

Fuse: fuse element, fuse current rating, minimum fusing current, cut-off current, fusing factor, Fuse material, types of fuses: Re-wirable, cartridge fuses (HRC and LRC), Fuse material Selection of fuse.

Miniature circuit Breaker (MCB): Construction working principle rating and uses in electrical circuit.

Earth Leakage Circuit Breaker (ELCB): Construction, working Principle rating and uses in electrical circuit.

Earthing: System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current, Measurement of earth resistance using earth tester, Methods of reducing earth resistance, Electrical Engineering Curriculum Structure 172 Methods of earthing as per IS 3043: 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing.

Unit– IV Electrical Wiring System & its Various Methods

Wiring System: Factors determining the selection of wiring methods, IS: 732-1983 wiring rules, various wiring methods

PVC casing-capping wiring: Basics fundamentals of casing -capping wiring, casing- capping wiring accessories advantages, and limitations.

Conduit Wiring: Conduit wiring its types of conduits, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring,

Modular Wiring: Basics fundamentals of modular wiring, modular wiring accessories advantages, and limitations.

Comparison of various wiring systems, General BIS rules for domestic installations.

Unit– V Estimating & Costing of Powering/Wiring System

Estimating & Costing of Domestic Powering/Wiring System: Standard practices as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate.

Estimating & Costing Industrial Powering/ Wiring Sysyem: relevant IE rules and standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with singe-phase, 3-phase motor load and the lighting load (3-phase supply system).

Estimating & Costing of Service Line: Service line connections estimate for domestic and Industrial loads (overhead and Under- ground connections) from pole to energy meter.

Estimating & Costing of Earthing System: IS specifications regarding earthing, types of earthing, List of materials required for earthing, Design of earth wire/strip and electrode for domestic and industrial installation.

References:

1. Raina, K.B. and S.K. Bhattacharya, Electrical Design Estimating and Costing, New Age International Ltd., New Delhi, ISBN 978-81-224-0363-3
2. Allagappan, N. S.Ekambarram, Electrical Estimating and Costing, New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, DhanpatRai and Co. New Delhi, ISBN: 1234567150995

4. Gupta, J B: A Course in Electrical Installation Estimating and Costing, S K Kataria and Sons, New Delhi, ISBN:978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation
6. Bureau of Indian Standard, SP 30 National Electrical Code 2010
7. Bureau of Indian Standard, SP 72 National Lighting Codes 2010
8. **E-REFERENCES:-**

- (i) <http://nptel.ac.in/courses/108108076/1> , assessed on 18th January 2016
- (ii) <http://www.electrical4u.com>, assessed on 18th January 2016
- (iii) <https://www.youtube.com/watch?v=A9KSGAnjo2U>, assessed on 18th January 2016
- (iv) <http://www.electricaltechnology.org/2015/09>, assessed on 30 Jan 2016
- (v) www.slideshare.net/bawaparam/made-by-param assessed on 30 Jan 2016
- (vi) www.electricaltechnology.org/2013/09/electrical-wiring.html assessed on 16 March 2016.

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Select accessories, wires, cables and wiring systems for electrification.
2. Design electrical wiring installation system for residential unit.
3. Design proper illumination scheme for residential unit.
4. Prepare wiring layouts on wiring board.
5. Locate and diagnose faults in electrical wiring installation.
6. Do proper earthing for building electrification

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	8	8
2	14	13
3	14	13
4	14	13
5	14	13
Total	64	60

Course Code	:	EEEEOE302
Course Title	:	Nanotechnology
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

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 provide basic knowledge of nanoscience & nanotechnology.
- To make students familiar with nanoelectronic devices
- To make students familiar with Applications of nanomaterials.

Unit-I : Introduction to Nanoscience, nanoscale, nanoparticles

Unit-II : Nanotechnology: History, Top down and Bottom up approaches with fabrication and future scope of nanotechnology.

Unit-III : Properties of nanomaterials: Electronic, magnetic, optical, chemical and mechanical properties.

Unit-IV : Nanoelectronics Devices: Computer, Memory, Integrated Circuit , CMOS Technology, Optoelectronic Devices.

Unit-V : Applications of nanomaterials and Nanotechnology: Nanostructured materials in memory and electronic devices and for magnetic recording, sensors and interfaces, Medicine, Energy, Electronics, Environment protection, Agriculture etc.

References:

1. Michael Köhler, Wolfgang Fritzsche, Nanotechnology An Introduction to Nanostructuring Techniques, Approved in Academic Council held on 25.10.2021 Wiley, 2nd edition, (2008).
2. G. Cao, Y. Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific Series in Nanoscience and Nanotechnology, 2nd edition (2011).
3. Charles P. Poole, Jr., Frank J. Owens, Introduction to Nanotechnology, Wiley, (2003).
4. Bhushan, Bharat (Ed.), Springer Handbook of Nanotechnology, Springer-Verlag Berlin Heidelberg (2017).
5. Guozhong Cao and Ying Wang, World Scientific Series in Nanoscience and Nanotechnology: Volume 2 , Nanostructures and Nanomaterials, Synthesis, Properties, and Applications, 2nd Edition (2011).

E-references:

1. NPTEL course contents links
2. <https://nanohub.org/groups/education>

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Students will be able to learn basics of nanotechnology.
2. Students will learn the difference in semiconductor devices with nanoelectronics devices
3. Applications of nanotechnology in their respective fields as well as in interdisciplinary science and engineering.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	08	10
2	12	12
3	14	14
4	14	12
5	16	12
Total	64	60

Course Code	:	EEEEOE304
Course Title	:	Industrial Drives
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

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

- Maintain electric AC and DC Drives

Unit – I Electric Drives

Need of Electric Drives, Functional Block diagrams of an electric drives.

DC Motors, Motor Rating

- a. Series, Shunt and compound DC motors.
- b. Universal motor
- c. Permanent magnet motor
- d. DC servo motor
- e. Moving coil motor
- f. Torque motor.

Starting and Braking of DC Motors

Brushless DC Motors for servo applications.

Maintenance procedure.

Unit – II AC Motors

Single phase AC Motors

- a) Resistance split phase motors
- b) Capacitor run motors
- c) Capacitor start motors
- d) Shaded pole motors

Three phase Induction Motors

- a) Squirrel cage Induction motor
- b) Slip ring Induction Motor
- c) Starting methods of Induction Motor
- d) Braking methods of Induction Motor

Determination of Motor Rating

Maintenance procedure.

Unit– III DC Drives

Single phase SCR Drives

- a) Half wave converter
- b) Full wave converter
- c) Semi converter
- d) Dual converter

Three Phase SCR Drives

- a) Half wave converter
- b) Full wave converter
- c) Semi converter
- d) Dual converter

Reversible SCR Drives.

Speed control methods of DC series Motor

Chopper Controlled DC Drives

Solar and battery powered vehicles

Maintenance procedure.

Unit– IV AC Drives

Starting and Braking of Induction motors.

Stator voltage control

Variable Frequency Control

Voltage Source Inverter Control

Current Source Inverter Control

Rotor Resistance Control

Slip Power Recovery

Solar powered pump drives

Maintenance procedure for AC drives

Sequences of stages & drives required in each stage for following applications:

- a) Textile mills
- b) Steel rolling mills
- c) Paper mills
- d) Sugar mills

Unit– V Advanced Techniques of Motor Control

Microcontroller/ Microprocessor based control for drives

Phase locked loop control of DC motor.

AC/DC motor drive using Microcomputer control

AC/DC motor drive using Microcontroller control.

Synchronous Motor drives.

Ratings & specifications of stepper motor.

Stepper motor drives employing microcontroller (No programming)

References:

1. P.S. Bimbhra, Electric Machines, Khanna Book Publishing Co., New Delhi (ISBN: 978- 93-86173-294)
2. Saxena, S.B Lal ; Dasgupta, K., Fundamentals of Electrical Engineering, Cambridge university press pvt. Ltd., New Delhi, ISBN: 9781107464353
3. Theraja, B. L. ; Theraja, A. K., A Text Book of Electrical Technology Vol-II, S. Chand and Co. Ram nagar, New Delhi, ISBN : 9788121924405
4. Mittle, V.N. ; Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 9780070593572
5. Sen P.C., Power Electronics, Mcgraw-Hill Publishing Company Limited, New Delhi. ISBN: 9780074624005
6. Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi. ISBN :9788173194283
7. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw- Hill

- Publishing Company Limited, New Delhi.ISBN:9780070701991
8. Agrawal , Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN 9788177588859.
9. Deshpande M.V., Design and Testing of Electrical Machines, PHI Publication, ISBN: 9788120336452
10. Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN :13: 978-0470213995

Course outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Select relevant DC motor for various electric drive applications.
2. Select relevant AC motor for various electric drive applications.
3. Maintain DC Drives.
4. Maintain AC Drives.
5. Maintain microprocessor/micro controlled electric motors

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	15	15
3	15	15
4	12	10
5	10	10
Total	64	60

Course Code	:	ECEO301
Course Title	:	PLC & Automation
Number of Credits	:	3 (L:3,P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objective:

1	Understand automation technologies and identify advantages, limitations and applications of the same
2	Develop ability to recognize, articulate and solve industrial problems using automation technologies
3	To understand the generic architecture and constituent components of a Programmable Logic Controller.

Course Content

Unit I : Introduction

1. Introduction to Automation
 - 1.1 Definition
 - 1.2 Role of Automation
 - 1.3 Industrial Applications
 - 1.4 History of Automation

Unit II: Automation Components

- 2.1 Relays: Concept of relays, Relay wiring for logic gates
- 2.2 Switches and its types
- 2.3 Sensors:
Working principal of Optical Sensors, Capacitive Sensors, Inductive Sensors, Ultrasonic Sensors, Fluid flow Industrial Sensors, Angular displacement (Potentiometers, Encoders, tachometers), Linear Position (LVDT), Forces and Moments (Strain gages, Piezoelectric), Liquids and Gases (Pressure, Venturi valves, Magnetic and Ultrasonic flow meter, Pilot Tubes), Temperature (RTDs, Thermocouples, Thermistors), Light (LDR).
- 2.4 Concept of Control Actuators, Different types) Control Actuators (Solenoids, Valves, Hydraulics, Pneumatics

Unit III: PLC (Programmable Logic controller)

- 3.1 Introduction, Advantages of PLC control Panel, Architecture of PLC, - Functions of various Blocks of PLC, Working principle of PLC, Memory types , Different types of Input/Output circuits
- 3.2 Concept of inputs and outputs:Concept of Digital inputs and outputs, Concept of Analog inputs and outputs

- 3.3 Concept of sink and source input/ output cards
- 3.4 Programming Methods, Programming devices, Programming with PLC
- 3.5 Basic Instructions - NO and NC contacts
- 3.6 Boolean gates - symbols and truth tables
- 3.7 Introduction to Ladder Logic programming
- 3.8 Concept of latching and unlatching
- 3.9 Timers and counters
- 3.10 Maintenance and Trouble Shooting of PLC
- 3.11 Selection of PLC
- 3.12 Applications

Unit IV: Programing Instructions

User and Bit Functions, Timer and Counters, Input / Output, Compare Compute/math Instructions, Move and Logical Instructions

Course Outcomes:

CO1	Identify different types of Automation systems.
CO2	Understand the basics of PLC programming
CO3	Understand the different parameters of PLC.
CO4	Design different process control applications through ladder logic

SUGGESTED LEARNING RESOURCES:

1. Introduction to Transducers by Arun K. Ghosh, PHI Learning
2. Transducers Engineering by S. Vijayachitra , PHI Learning
3. Programmable Logic Controller Jadhav, V. R. Khanna publishers, New Delhi
4. PLCs & SCADA Theory and Practice, Rajesh Mehra , Vikrant Vij,Laxmi Publications Private Limited.
5. PLC and Automation, Mahesh S. Patil , Rahul K. Sarawale, Nirali Prakashan

Suggested Distribution of Marks (For Paper Setters and Students)

Topic /Unit	Time (In Hrs.)	Marks Allotted
1	06	03
2	22	18
3	24	24
4	14	15
Total	64	60

Course Code	:	ECEO302
Course Title	:	Satellite and Cellular Communication
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objective:

1	Understand the basics of satellite Communication and its Applications.
2	To understand the design of cellular systems.
3	To understand the evolution of Communication Generations

Course Content

Unit 1: Introduction to Satellite Communication

- 1.1 Evolution and growth of communication satellite. Need for satellite communication.
- 1.2 Advantages of satellite communication
- 1.3 Active & Passive satellite
- 1.4 Orbital aspects and their effects on satellite communications.

Unit 2: Satellite Applications

- 2.1 INTELSAT Series, INSAT, VSAT
- 2.2 Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO
- 2.3 Satellite Navigational System. GPS Position Location Principles
- 2.4 Differential GPS, Direct Broadcast satellites (DBS/DTH).

Unit 3: Cellular Communication Concepts

- 3.1 Introduction of cellular communication, Formation of Cell, frequency reuse concept.
- 3.2. Classification of Cells, Umbrella cell concept.
- 3.3 Channel assignment strategies.
- 3.4 Handoff, Hard and Soft handoff, Handoff strategies.
- 3.5 Interference, Co channel and Adjacent channel interference.
- 3.6 Estimation of cellular system capacity.
- 3.7 Cellular system capacity improving techniques; Cell splitting, Sectoring, Microcell zone concept.

Unit 4: Evolution of Communication Generations:

- 4.1 2.5G TDMA evolution path, GPRS technology,
- 4.2 EDGE technology, 2.5G CDMA technology,
- 4.3 Need of 3G and 4G mobile networks,
- 4.4 Introduction to CDMA 2000 technology. Comparison between GSM and CDMA technologies.
- 4.4 LTE-Advance systems, 4G & 5G Mobile techniques and Emerging technologies.

Course Outcomes:

CO1	Analyze the satellite orbits
CO2	Design various satellite application
CO3	To understand the design of a cellular system
CO4	Illustrate the generations of telecommunication systems in wireless network

SUGGESTED LEARNING RESOURCES:

1. Dennis Roddy —Satellite Communication, 4th Edition, Mc Graw Hill International, 2006.
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication,2nd Edition, Wiley Publications,2002
3. Wireless Communications and Networking, by William Stallings.
4. Wireless Communications, Principles and Practice, by Theodore S.Rappaport.

Suggested Distribution of Marks (For Paper Setters and Students)

Topic /Unit	Time (In Hrs.)	Marks Allotted
1	10	09
2	18	18
3	16	15
4	20	18
Total	64	60

Course Code	:	ECEOE304
Course Title	:	Optical Fibre Technology
Number of Credits	:	3 (L:3, P:0, DCS:1)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

1	To provide a comprehensive understanding of the fundamental principles of optical fibre technology.
2	To develop an understanding of optical fibre characteristics and the factors that affect them.
3	To introduce the students to the design of fibre optic communication systems and their applications.
4	To familiarize the students with the use of fibre optic sensors in various fields.
5	To introduce the students to the basics of optical amplifiers and their applications.

COURSE CONTENT: -

1. Introduction to Optical Fibre

Technology 1.1 Introduction to Optical Fibres ,

1.2 Types of Optical Fibres on the basis of refractive index profile & on the basis of modes, 1.3 Advantages and Limitations of Optical Fibres

2. Optical Fibre Characteristics

2.1 Attenuation and Dispersion in Optical Fibres, 2.2 Numerical Aperture and Acceptance Angle 2.3 Optical Fibre Modes

3. Fibre Optic Communication Systems

3.1 Working principle of Optical Sources (LED, LASER DIODE),
3.2 Working principle of Detectors (PIN TYPE, AVALANCHE TYPE)
3.3 Block diagram of Fibre Optic Transmitters and Receivers
3.4 Modulation Techniques (ASK, FSK)
3.5 Multiplexing Techniques (TDM, WDM)

4. Fibre Optic Sensors

4.1 Types of Fibre Optic Sensors
4.2 Principle of Operation of fabry-perot interferometer (fpi) sensor & fiber optic gyroscope (fog) sensor

5. Optical Amplifiers

5.1 Types of Optical Amplifiers
5.2 Working principle of Erbium-doped Fibre Amplifiers
5.3 Working principle of Semiconductor Optical Amplifiers (SOA)

6. Fibre Optic Networks

6.1 Classification of optical networks

6.2 Hybrid Fibre-Coaxial (HFC)

Network 6.3 Passive Optical

Network (PON)

6.4 SONET/SDH

6.5 OTDR method of testing network.

Course Outcomes:

CO1	Understand the principles of optical fibre technology
CO2	Analyze and design optical fibre networks
CO3	Apply optical fibre sensors for various applications
CO4	Troubleshoot optical fibre systems

SUGGESTED LEARNING RESOURCES

1. G. Keiser, Optical Fiber Communication, Tata McGraw Hill, 2013.
2. J. M. Senior, Optical Fiber Communications, Pearson Education, 2010.
3. G. P. Agrawal, Fiber Optic Communication Systems, John Wiley & Sons, 2002.

SUGGESTED DISTRIBUTION OF MARKS (For Paper Setter & Students)

UNIT	Time in Hours	Percentage Distribution of Marks
1	8	07
2	12	12
3	20	20
4	8	07
5	8	07
6	8	07
Total	64	60

Course Code	:	ITOE301
Course Title	:	Cyber Laws & Ethics
Number of Credits (Teaching Load)	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

In the age of the internet, our lives are increasingly dependent on online shopping, banking, and socializing. We store personal information on our computers and in the cloud. Hence, in modern society, cybersecurity and data protection are major challenges to combat. This introductory course is designed to create an awareness among the students about various challenges pertaining to the cyberworld and legal frameworks to deal with a new set of challenges arising thereof.

Course Outcomes

After completing this course the students will be :

- CO-1. Conversant with the basic terminology of the cyberworld.
- CO-2. Having thorough knowledge about cyber ethics and code.
- CO-3. Having awareness about the legal framework to combat cybercrimes.
- CO-4. Having awareness about IPRs and their protection.

Course Content

Unit-1 : Cyber Ethics & Etiquettes 15 Marks

History of the Internet, Major Applications of the Internet - Email, WWW, Social Media, Online Payment, Online Gaming; Digital Footprints, Cyberworld, Digital Society and Netizen, Net Etiquettes, Cyber Ethics; Impact of the Internet on Society, Impact of Digital Technologies on Health, Government Guidelines and Digital Media Ethics Code

Unit-2 : Basics of Cybersecurity 15 Marks

Need for Cybersecurity, Challenges in Cybersecurity; Cybersecurity Framework; Cybercrime - Hacking, Phishing, Fraud Emails, Identity Theft, Ransomware, Cyber Stalking/ Harassment, Cyberbullying, Pornography, Cyber Terrorism, Cyber Defamation; Combatting and Preventing Cyber Crime; Prevention from Cybercrime using self-regulation; National Cyber Security Strategy

Unit-3 : Intellectual Property Rights 15 Marks

Data Protection, Right to Privacy and Data Protection, Intellectual Property Right (IPR), Copyright, Patent, Trademark; Scopes of Copyrights, Patents and Trademark; Violation of IPR -

Plagiarism, Copyright Infringement, Trademark Infringement;

Unit-4 : Cyber Laws in India **15 Marks**

Major Provisions for Cybercrime under Indian Penal Code (IPC), Indian IT Act-2000 (Sections 65, 66, 67, 69); Digital Personal Data Protection Act 2023, Intellectual Property Rights, Patent Law, Copyright Law, Digital Signatures

Reference Books

1. Information Security and Cyber Laws, Sarika Gupta, Khanna Publishing House
2. Intellectual Property Rights by Dr. S.K. Singh, Central Law Agency
3. Cyber Law-Law Of Information Technology & Internet by Anirudh Rastogi, LexisNexis
4. Acts, Laws and Standards (IT Act, ISO27001 Standard, IPR and Copyright Laws)
5. GoI website <https://www.indiacode.nic.in>

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
Unit 1 : Cyber Ethics & Etiquettes	16 Hrs	15
Unit 2 : Basics of Cybersecurity	16 Hrs	15
Unit-3 : Intellectual Property Right	16 Hrs	15
Unit-4 : Cyber Laws in India	16 Hrs	15
Total	64 Hrs	60

Course Code	:	ITOE302
Course Title	:	Fundamentals of Blockchain Technology
Number of Credits (Teaching Load)	:	3 (L: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

Contracts and transactions are at the heart of our modern society. Their paper-based and digital records define the most important structures of our administrative, economic, legal, political, and social systems by setting associated regulatory boundaries. They govern interactions among nations, public and private organizations, communities, and individuals worldwide. This is why they are frequently subject to digital abuse and fraud, which is why cybersecurity is more important than ever in the digital age. Blockchain technology promises to play a crucial role in this context since it might be as disruptive for data integrity and recording as the Internet has been for data access and exchange. This course is meant to expose the students to Blockchain technology and its applications.

Course Outcomes

After completing this course the students will be :

- CO-1. Conversant with the basic terminology of Blockchain technology.
- CO-2. Having knowledge about various application areas of Blockchain.
- CO-3. Having an understanding of distributed computing and cryptography.

Course Content

Unit-1 : Introduction to Blockchain 15 Marks

Centralized, Decentralized and Distributed Systems; P2P Systems, Concept of Trust in Distributed Computing, Evolution of Blockchain, Importance of Blockchain Technology, Blockchain Structure, Characteristics of Blockchain - Distributed Consensus, Cryptography, Immutability; Applications of Blockchain, Blockchain Types - Public, Private and Consortium

Unit-2 : Blockchain Components 15 Marks

Elements of a Blockchain, Nodes in Blockchain, Concept of Distributed Ledger, Consensus Algorithms - PoW and PoS, Structure of a Block, Blockchain Transactions, Cryptography, Plaintext and Ciphertext, Symmetric and Asymmetric Ciphers, Public/ Private Key Cryptography, Encryption and Decryption, Hashing, Challenges in Blockchain - Double Spending, Sybil Attack; Hyperledger

Unit-3 : Cryptocurrency **15 Marks**

Concept of Money, Properties of Money, Currency, Fiat Currency, Cryptocurrency, Advantages and Disadvantages of Cryptocurrency, Bitcoin, History of Bitcoin, Ethereum, Ethereum Concepts - Ether and Gas; Cryptocurrency Wallets, Concept of Cryptocurrency Mining

Unit-4 : Other Applications of Blockchain **15 Marks**

Smart Contracts, Non Fungible Tokens, Web 3.0, Digital Assets, Web 3.0, Application of Blockchain in e-Governance, Land Record, Digital Certificates, Insurance, Supply Chain, Identity Management, E-Voting, IoT

Reference Books

1. Ethereum: The Insider Guide to Blockchain Technology, Cryptocurrency and Mining
Ethereum by Richard Ozer, Createspace Independent Publication
2. Blockchain for Beginners by Kurt Dugan, CRB Publishing
3. The Basics of Bitcoins and Blockchains by Antony Lewis, Two Rivers Distribution
4. Distributed Ledger Technology: The Science of the Blockchain by R.P. Wattenhofer,
Inverted Forest Publishing

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
Unit 1 : Introduction to Blockchain	16 Hrs	15
Unit 2 : Blockchain Components	16 Hrs	15
Unit-3 : Cryptocurrency	16 Hrs	15
Unit-4 : Other Applications of Blockchain	16 Hrs	15
Total	64 Hrs	60

Course Code	:	ITOE304
Course Title	:	Multimedia Applications
Number of Credits (Teaching Load)	:	3 (L : 3, DCS : 1, P : 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

The objective of this course is to introduce students to the domain of Multimedia applications, which entails the technologies underlying digital images, videos and audio contents and interactive media.

Course Outcomes

After completing this course the students will be able to :

CO-1. Understand the basic terminology associated with multimedia technologies.

CO-2. Explain various applications of multimedia technology.

CO-3. Understand the basic multimedia compression techniques.

Course Content

Unit 1 : Introduction to Multimedia 15 Marks

Multimedia, Multimedia Elements, Multimedia Hardware - GPU, Digital Camera, Scanner, Projector, Printer, MIDI Synthesizer, Light Pen, Touch Screen, Microphone, Speakers; Multimedia Software - Raster Graphics and Vector Graphics Editing Software, Audio and Video Editing Software, Multimedia Authoring, Video and Audio Data Compression Techniques – Lossy and Lossless

Unit 2 : Multimedia Applications 15 Marks

Video on Demand, Video Streaming, Multimedia Conferencing, Interactive Television, Educational Applications, Social Media, Healthcare, Augmented Reality, Virtual Reality, Visual Effects (VFX), Modelling and Simulation, Marketing, Business Presentations

Unit 3 : Computer Graphics 15 Marks

Raster and Vector Graphics, Basic Terminology - Coordinate System, Pixel, Bitmap, Resolution, Dot Pitch, Color Depth, Aspect Ratio, Gamut, Color Models - RGB, CMYK, HSL; Aliasing, 2D Transformations - Translation, Rotation and Scaling; Vector Graphics Primitives, Shapes, Anchor Points, Bezier Curves, Combining Shapes - Union, Intersection, Exclusion and Minus; Stroke and Fill, Features of Adobe Illustrator, Features of Adobe Photoshop and Adobe Illustrator

Unit 4 : Digital Audio & Video 15 Marks

Characteristics of Audio - Frequency, Amplitude, Envelope; Digitization of Sound, Sampling

and Quantization, Synthetic Sound, MIDI, Digital Video, Basic Principles of Animation, Animation Terminology - Timeline Frames, Keyframes, Layers, Tweening, 2D and 3D Animation, Introduction to different MPEG standards - MPEG-1, MPEG-2, MP3, AAC.

Reference Books & Online Resources

1. Elements of Multimedia by Sreeparna Banerjee, CRC Press
2. Fundamentals of Multimedia by Ze-Nian Li et al., Springer
3. Multimedia Foundations by Vic Costello, Routledge Publication
4. Online Tutorials on Adobe Photoshop and Illustrator

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
Unit 1 : Introduction to Multimedia	16 Hrs	15
Unit 2 : Multimedia Applications	16 Hrs	15
Unit 3 : Computer Graphics	16 Hrs	15
Unit 4 : Digital Audio & Video	16 Hrs	15
Total	64 Hrs	60

Course Code	:	IEOE301
Course Title	:	Power Plant Instrumentation
Numbers of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives: The objective of this course is to familiarize the students of different streams with the basic concepts, equipments or systems used in Power Plant based on Instrumentation or Process Control.

COURSE CONTENT

UNIT-I: Power Generation

- 1.1 Renewable & Non-Renewable Sources of Electricity.
- 1.2 Concept of Power Generation- Schematic Block Diagram of Hydro, Thermal, Nuclear, Solar & Wind Power Plant.
- 1.3 Importance of Instrumentation in Power Plants.

UNIT-II: Essential Process Parameter Measurement Concepts in Power Plants

- 2.1 Measurement of Temperature.
- 2.2 Measurement of Pressure.
- 2.3 Measurement of Flow. 2.4 Measurement of Level.
- 2.5 Measurement of Vibration.

UNIT-III: Process Control/Instrumentation in Water Treatment

- 3.1 Process Control/Instrumentation in Pre Water Treatment.
- 3.2 Process Control/ Instrumentation in DM Water Treatment Plant.
- 3.3 Instrumentation in Effluent Treatment Plant.
- 3.4 Instrumentation in Sewage Treatment Plant.

UNIT-IV: Important Control Loops in Steam Generation

- 4.1 Introduction to Steam Generator (Boiler).
- 4.2 Boiler Feed Water Control.
- 4.3 Boiler Air/Fuel Ratio Control.
- 4.4 Boiler Combustion Control.
- 4.5 Boiler Drum Level Control.
- 4.6 Boiler Steam Temperature Control. 4.7 Boiler Deaerator Control.
- 4.8 Boiler Superheating Control.

UNIT-V: Turbine – Monitoring & Control

- 5.1 Introduction to Turbine.
- 5.2 Turbine – Steam Pressure Monitoring & Control.

5.3 Turbine – Temperature Monitoring & Control.

5.4 Turbine – Vibration Monitoring & Control.

5.5 Turbine – Speed Monitoring & Control.

Reference Books:

1. Power Plant Engineering; P. K. Nag; TMH Publishers.
2. Power Plant Engineering; R. K. Rajput; Laxmi Publications.
3. Power Plant Instrumentation; K. Krishnaswamy; PHI.
4. Boiler Control Systems Engineering; G.F. Gilman; ISA Publication.
5. Instrument Engineer's Handbook; Bela G Liptak; CRC Press.

Course Outcome:

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

CO-1: Learn the concept of power generation

CO-2: Need of Instrumentation in Power Plants

CO-3: Various Control or Process Control Methodology

CO-4: Importance of Instrumentation in Smooth Power Plant Operation.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time (in Hours)	Marks Allotted
1	12	12
2	10	6
3	12	12
4	18	18
5	12	12
Total	64	60

Course Code	:	IEOE302
Course Title	:	Automation Solutions
Numbers of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives: The objective of this course is to familiarize the students of different streams with the basic concepts of Automation, PLC, DCS & Robotics.

COURSE CONTENT

UNIT-I: Overview of Automation

- 1.1 Idea on PID.
- 1.2 Idea on a close loop system with real example of different instrument needed.

UNIT-II: Programmable Logic Controller

- 2.1 Introduction to PLCs, Areas of applications.
- 2.2 Architecture of a typical PLC, operation of PLC.
- 2.3 Difference between PLC and Hardware system, Relay logic and Ladder Logic.
- 2.4 Programming of PLCs, systematic solution finding.
- 2.5 Programming languages, PLC Programmers, PC interface.
- 2.6 Function block diagram, ladder diagram, instruction list, structured text.
- 2.7 Sequential function chart, logic control systems, timers, counters.
- 2.8 Commissioning and operational safety of a PLC, data transmission interface and communication in the field area.
- 2.9 Guidelines and standards.

UNIT-III: Distributed Control System:

- 3.1 Features of DCS.
- 3.2 PLC and DCS – a comparative study.
- 3.3 Architecture of a Typical DCS system.
- 3.4 Advantage & Disadvantage of DCS.
- 3.5 Hardware arrangement of DCS for a complete close loop system for analog as well as digital control.
- 3.6 Concept of graphic panel, control panel, tuning panel, alarm panel etc.

UNIT-IV: Concept of Robotics

- 4.1 Definition of Robot and Robotics, functional components of Robot.
- 4.2 Different types of robot joints, workplace, work volume, work envelop degree of freedom of robot.
- 4.3 Common types of configuration used in major linkage or arm. 4.4 Description of Cartesian coordinate robot.

4.5 Robot Sensors: internal (joint position, speed sensor, acceleration, force, torque), external tactile, proximity, long range).

4.6 Robot application- loading unloading, material handling etc.

Reference Books:

1. Process Control Instrumentation Technology; Curtis D. Johnson; PHI.
2. Process Control Principles and Applications; Surekha Bhanot; Oxford.
3. PID Controllers: Theory, Design and Tuning; Karl J. Aström and Tore Hägglund; Instrument Society of America.
4. Instrument Engineer's Handbook; Bela G Liptak; CRC Press.
5. Programmable Logic Controller; Vijay R. Jadhav; Khana Publishers.
6. Programmable Logic Controllers; Weib & Reis; PHI
7. Robotic Technology and Flexible Automation; S R Deb & S Deb; TMH
8. Robotics Engineering; Klafter, Chmielewski & Negin; PHI

Course Outcome:

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

CO-1: Understand the basic concept of Automation.

CO-2: Understand about PID Controller.

CO-3: Enhance knowledge about PLC.

CO-4: Enhance knowledge about DCS

CO-5: Understand about Robotics.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time (in Hours)	Marks Allotted
1	10	12
2	20	18
3	17	15
4	17	15
Total	64	60

Course Code	:	IEOE304
Course Title	:	Computer Aided Instrumentation
Numbers of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives: The objective of this course is to familiarize the students of different streams with the basic concepts of Computer/PC Based Instrumentation.

COURSE CONTENT

UNIT-I: Introduction:

- 1.1 General structure of PC based instrumentation.
- 1.2 Advantages and disadvantages of computer based instrumentation.
- 1.3 Comparison with other systems.

UNIT-II: Buses & Other Interfaces:

- 2.1 Introduction.
- 2.2 Expansion Buses- ISA bus, EISA bus, PCI bus.
- 2.3 Serial Interface- RS232, RS422 & RS 485.
- 2.4 Universal Serial Bus (USB). 2.5 GPIB.

UNIT-III: Computers in Process Control:

Programmable controller, Data logging, Supervisory control, Computer based controller.

UNIT-IV: Linear Circuit and Signal Conditioning:

Op-Amps, Instrumentation Amplifiers and Signal Conditioning, Multiplexer and De-Multiplexer, ADC and DAC.

UNIT-V: Parallel Port

Introduction to parallel port, Standard Parallel, Enhanced parallel port, Enhanced Capabilities port.

UNIT-VI: Use of Instrumentation Software Package:

Basic use of:

1. LabVIEW. 2. MATLAB. 3. MULTISIM.

Reference Books:

1. PC Based Instrumentation; N. Mathivanan; PHI.
2. Advanced Instrumentation & Computer I/O Design; Patrick H. Garrett; Wiley.
3. PC Based Instrumentation & Control; Mike Tooley; Routledge.
4. PC Interfacing for Data Acquisition & Process Control; Sanjay Gupta; ISA.
5. Virtual Instrumentation using LabVIEW; Jovitha Jerome; PHI.

Course Outcome:

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

CO-1: Know Bus Standard.

CO-2: Know about Serial & Parallel Port, USB.

CO-3: Know about Linear Circuits & Signal Conditioning.

CO-4: Know about various controllers of Process Control.

CO-5: Know the basics of LabVIEW, MATLAB & MULTISIM.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted
1	6	6
2	14	15
3	11	9
4	14	12
5	10	9
6	9	9
Total	64	60

Course Code	:	MEOE301
Course Title	:	Renewable Energy Technologies
Number of Credits	:	3 (L:3,DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning 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 Content:

UNIT-I: (12Hrs)

Introduction: World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilization; Renewable Energy Scenario in India and around the World; Potentials; Achievements/Applications; Economics of renewable energy systems.

Unit-II: (13Hrs)

Solar energy: Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation; Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; Solar PV Applications.

Unit-III (13Hrs)

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: (13Hrs)

Bio-Energy: Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Biodiesel; Cogeneration; Biomass Applications.

Unit-V: (13Hrs)

Other Renewable Energy Sources: Tidal energy; Wave Energy; Open and Closed OTEC Cycles; Small Hydro-Geothermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

Reference Books:

1. O.P. Gupta, Energy Technology, 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.
7. Energy and The Environment, RA Ristinen and J J Kraushaar, Second Edition, John Willey

- & Sons, New York
8. Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006.

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

CO1	Understand present and future energy scenario of the world.
CO2	Understand various methods of solar energy harvesting.
CO3	Identify various wind energy systems.
CO4	Evaluate appropriate methods for Bio-energy generations from various Bio-wastes.
CO5	Identify suitable energy sources for allocation.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	13	12
3	13	12
4	13	12
5	13	12
Total	64	60

Course Code	:	MEOE302
Course Title	:	Installation Testing and Maintenance
Number of Credits	:	3(L:3, DCS:1, P:0)
Pre requisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To explain the concept of testing, repair and maintenance
- To comprehend the procedure for erection and commissioning of machines.
- To provide adequate information, confidence and experience to handle any issue or problem related to mechanical equipment during operations
- To understand the inspection schedules and activities and maintenance requirements to be able to contribute to better and more efficient mechanical equipment and lesser repair costs

Course Content:

UNIT-I:

(12Hrs)

Introduction: Necessity of testing, repair and maintenance; manpower planning and materials management.

Execution and Commissioning of Machines (Installation): Location, layout and positioning of machines; Foundation - types of foundation. Brief description of following:- Foundation plan, Foundation bolts, erection and leveling, grouting, vibration damping.

Unit-II:

(19Hrs)

Inspection, Servicing, Repair & Overhauling of machines and equipment : Inspection of various machines and equipment; Servicing of various machines and equipment; Repair of various machines and equipment; Overhauling of various machines and equipment.

Maintenance planning & stages of maintenance: Maintenance planning; Various stages of maintenance; Maintenance schedules.

Unit III:

(14Hrs)

Reliability Centred Maintenance (Introduction only): Reliability; Availability; Maintainability

Overhauling: Frequent failure of common parts, their causes & remedial measures.; Overhauling schedule and procedure.; Repair and maintenance of Parts which require frequent maintenance to avoid downtime.; Fault diagnosis and action against fault.

Unit-IV:

(19Hrs)

Maintenance: Meaning of maintenance; advantages & disadvantages; Types of maintenance:- Preventive, predictive & breakdown maintenance.; Maintenance organization.; Centralized maintenance & decentralized maintenance.

Storage of parts: Storage of parts used frequently for replacement and parts which are not easily available in local market.; History cards of different machines.; Machines repair/replacement decision.

Reference Books:

1. Industrial Maintenance by HP Garg; S. Chand and Company.
2. Plant Maintenance Engineering by RK Jain; Khanna Publishers.
3. A Text book of Reability and Maintenance Engineering by Dr. A Manna, Prentice Hall of India.
4. Installation, Servicing and Maintenance by SN Bhattacharya; S. Chand and Company.
5. Installation, Maintenance, Servicing by AR Basu; M Dutta and Co., Calcutta. 115
6. Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt., Ltd., New Delhi.

Course out comes:

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

CO1	Understand the principles and objectives of Maintenance Engineering
CO2	Describe the various categories of maintenance.
CO3	Discuss various condition monitoring techniques
CO4	Understanding of international standards for safety and operational adherence

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	19	18
3	14	12
4	19	18
Total	64	60

Course Code	:	MEOE304
Course Title	:	Production Planning and Control
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

1. To analyze different planning activities needed during the operations stage of a manufacturing or a service industry.
2. To apply productivity techniques for achieving continuous improvement.
3. To critically analyze existing methods of doing the job and evolve efficient and economical methods.
4. To understand the applications of material handling equipment.

Course Content:

UNIT-I: (15Hrs)

Introduction: Types of production. - Job, batch and mass production; Concept of planning, scheduling, routing, dispatching and follow up; Break even analysis

Plant Location and Layout: Factors affecting the site selection of plant; Factors affecting plant layout; Types of layout - Process, product, combination and fixed position.

Unit-II: (13Hrs)

Inventory Control: Material purchasing; store keeping; functions and duties of store department; Definition of inventory; Types of inventory; ABC analysis; Procurement cost; carrying charges; lead-time; reorder point; Economic ordering quantity; simple direct numerical problems; Concept of JIT

Unit-III: (12Hrs)

Inspection and Quality Control(Problems omitted): Inspection needs; types of inspection; stages of inspection; Statistical quality control; Process capability; Control charts for variables – X and R chart; control chart for fraction defectives (P chart); control chart for number of defects (C chart).

Unit-IV: (13Hrs)

Material Handling: Principles of material handling; Hoisting equipment - Fork lift truck, cranes; Conveying equipment - Package conveyor, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, belt conveyors, and pneumatic conveyors.

Repair and maintenance: Objectives and importance of maintenance; Different types of maintenance; Nature of maintenance problem; Range of maintenance activities; Procedure of preventive maintenance; Schedules of preventive maintenance; Advantages of preventive maintenance

Unit-V: (11Hrs)

Cost estimation and control(Problems omitted): Functions of cost estimation; Estimation procedure; Elements of cost; ladder of costs; Depreciation-concept and methods of calculating depreciation; Overhead expanses; Cost control - capital cost control (planning and scheduling) operating cost control.

Reference Books:

1. Industrial Engineering and Management by T.R. Banga and SC Sharma; Khanna Publishers, Delhi
2. Industrial Engineering and Management by O.P. Khanna; Dhanpat Rai and Sons, New Delhi
3. Production Management by C.L. Mahajan; Satya Parkashan Company Limited, New Delhi
4. Mechanical Costing, Estimation and Project Planning by CK Singh; Standard Publishers, New Delhi
5. A Text Book of Reliability and Maintenance Engineering by A Manna, Prentice Hall of India

Course outcomes

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

CO1	Explain Break even analysis to determine safe production levels and costing of industrial products.
CO2	Demonstrate the knowledge of selection of location for the new plant & optimizing the layout within the plant for smooth production.
CO3	Apply productivity techniques for continuous improvement in different functionalities of an industry.
CO4	Ability to apply the concept of inventory and supply chain management.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	15	15
2	13	12
3	12	11
4	13	12
5	11	10
Total	64	60

Course Code	:	IoTOE301
Course Title	:	Software Project Management
Number of Credits (Teaching)	:	3 (T: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

Software project management is an art and discipline of planning and supervising software projects. It will inculcate the students with the procedure of managing, allocating and timing resources to develop computer software that fulfills requirements.

Course Outcomes

After the course completion, the students would be able to:

- CO-1. Understand the basics of the software project management techniques.
- CO-2. Learn the feasible solution and optimum solution for the resource management.
- CO-3. Learn the time estimation and critical path for project.
- CO-4. Learnt about the application of probability techniques in the decision making.

Course Content

Unit 1: Introduction

14 Hours

Project - Programs, Subprojects and Portfolios. Software Project - Application Development, Process & Systems Reengineering Services, System Integration Services. Software Project Management Fundamentals, People, Process, and Product, PMI Processes, Software project phases, Organizational structures, Project charter, Statement of Work (SOW).

Unit 2: Project Planning

12 Hours

Development lifecycle models - Waterfall Model, V-Shaped Model, Iterative Model, Spiral Model, Agile Model. Matching lifecycles to projects, Project plans, Work Breakdown Structures (WBS).

Unit 3: Managing Goals, Time, and Costs

14 Hours

Formalizing the Project Goals. Techniques to Assess Value and Risks. Building a WBS, WBS Decomposition Styles, WBS Construction Methodologies. Estimation - Effort, Duration, and Resources. Budgeting and Accounting - Project Costs, Cost Element Structures, Determining the Project Costs, Determining the Project Costs.

Unit 4: Managing People and Organizing Communication

14 Hours

Managing People- Define Staff Requirements, Selection of Staff, Managing Staff, Management Styles. Project Organization Structures – Hierarchical, Matricial Organizations, RACI Matrix, Agile Teams. Managing Communication - Planning a Communication Strategy, Communication Styles. Meetings - Managing Meetings, Types of Meetings, Planning Poker.

Unit 5: Risk, Change and Configuration Management**10 Hours**

Risk management, Change control, Microsoft Project Management software, Configuration management process, configuration management audit.

Reference Books & Online Resources:

1. M. Cottrell and B. Hughes, Rajib Mall, "Software Project Management", McGraw-Hill, 6/e, 2019.
2. Kathy Schwalbe, "Information Technology Project Management", Cengage Learning, 7/e, 2013.
3. Adolfo Villafiorita, "Introduction to Software Project Management", CRC Press, Taylor & Francis Group, 2014.
4. D. J. Henry, "Software Project Management – A Real-World Guide to Success", Addison-Wesley, 2003.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1	14 Hrs	20
Unit 2	12 Hrs	18
Unit 3	14 Hrs	24
Unit 4	14 Hrs	20
Unit 5	10 Hrs	18
Total	64	100

Course Code	:	IoTOE302
Course Title	:	Data Warehousing and Data Mining
Number of Credits (Teaching Load)	:	3 (T: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

This course will introduce the concepts of data warehousing and data mining, which gives a complete description about the principles, uses, architectures, applications, design and implementation of data mining and data warehousing concepts.

Course Outcomes

After completing this course, the students will be able to:

- CO-1 Identify the scope and necessity of Data Warehousing Data Mining.
- CO-2 Understand the basic architecture of Data Warehousing.
- CO-3 Understand various tools of Data Mining and their techniques.
- CO-4 Understand the various trends and application of Data Mining

Course Content

Unit 1: Introduction to Data Warehousing ----- 14 Hours

Data Warehouse, OLTP, OLAP, comparison of OLTP and OLAP systems, three-tier data warehouse architecture, Data Warehouse Models: Enterprise warehouse, Data mart, Virtual warehouse, Types of OLAP Servers: Relational OLAP (ROLAP), Multidimensional OLAP (MOLAP), Hybrid OLAP (HOLAP).

Unit 2: Multidimensional Data Models ----- 10Hours

Multidimensional database, data cube, concept hierarchy, OLAP Operations: Roll-up, Drill-down, Slice and dice, Pivot (rotate), Schemas for multidimensional databases: Stars, Snowflakes, and Fact Constellations.

Unit 3: Data Mining & KDD Process ----- 14 Hours

Data Mining, Importance of data mining, KDD process: Data preprocessing, Data cleaning, Data integration, Data selection, Data transformation, Data mining, Pattern evaluation, Knowledge presentation. Classification of data mining systems, Technologies used in data mining, Major issues in Data Mining.

Unit 4: Building Data Warehouse ----- **14 Hours**

ETL process, Top-down approach, Bottom-up approach, Steps for Data warehouse design: choosing a business process to model, choosing the grain of the business process, choosing the dimensions, choosing the measures, Recommended approach for data warehouse development.

Unit 5: Applications & Trends in Data Mining ----- **12 Hours**

Data Mining Applications: Data Mining for Financial Data Analysis, Retails and Telecommunication Industries, Science and Engineering, Intrusion Detection and Protection, Recommendation System, Recent trends in data mining.

Reference Books & Online Resources

1. “Data Mining & Warehousing”, by Ikvinderpal Singh, Khanna Book Publishing Ltd.
2. “Data Mining, Data Warehousing”, by Parteek Bhatia, Cambridge University Press.
3. “Data Warehousing, Data Mining & OLAP”, by Alex Berson and S. Smith, TMH
4. “Data Mining – Concepts & Techniques” by Jiawei Han and Micheline Kamber, Elsevier.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1	14 Hrs	20
Unit 2	10 Hrs	18
Unit 3	14 Hrs	24
Unit 4	14 Hrs	20
Unit 5	12 Hrs	18
Total	64	100

Course Code	:	IoTOE304
Course Title	:	Wireless Sensor Network
Number of Credits (Teaching Load)	:	3 (T: 3, DCS: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Learning Objectives

This is one of the fundamental courses meant to understand the important concepts related to Wireless Sensor Networks

Course Outcomes

After the course completion, the students would be able to:

- CO-1. To understand the basics of Wireless sensor Networks.
- CO-2. To learn about the Architecture of WSN.
- CO-3. To understand the concept of Networking in WSN
- CO-4. To learn security requirements for WSNs.

Course Content

Unit 1: Introduction to Wireless Sensor Network (WSN) ----- 14 Hours

Wireless Network, Sensors, Wireless Sensor Network (WSN), Adhoc Network, Difference between Adhoc Networks and Wireless Sensor Network, Characteristics of WSN, advantages & disadvantages of WSN, Design challenges for WSN, Applications of Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Types of Wireless Sensor Networks.

Unit 2: Network Architecture for Wireless Sensor Networks ----- 14 Hours

Sensor Node, Sensor Node Structure, Components of Sensor Node, Network Architecture of WSNs – Flat Architecture and Hierarchical Architecture, Classifications of Wireless Sensor Networks, Protocol Stack for Wireless Sensor Networks, Optimization Goals and Figures of Merit.

Unit 3: WSN Networking Concepts and Protocols----- 14 Hours

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – S-MAC and B-MAC Protocol, WSN Communication technologies - IEEE 802.15.4, NFC, BLE and ZigBee. Internet wo WSN Communication, WSN Routing Protocols Energy-Efficient Routing, Geographic Routing.

Unit 4: Infrastructure Establishment ----- **10 Hours**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

Unit 5: Sensor Network Security ----- **12 Hours**

Network Security, Issues and challenges in Sensor Network Security, Security requirements – Availability, Confidentiality, Eavesdropping, Node Compromise, Authenticity, Packet Injection, Integrity, Freshness- Packet Replaying, Timestamp.

Reference Books & Online Resources:

1. Anna Forster, "Introduction to Wireless Sensor Networks", John Wiley & Sons, Inc., Publication 2016.
2. Sudip Misra, M. S. Obaidat, "Principles of Wireless Sensor Networks", Cambridge University Press
3. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks - A Networking Perspective", John Wiley & Sons, Inc., Publication
4. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

SUGGESTED DISTRIBUTION OF MARKS		
Unit No.	Time Allotted (Hrs)	Marks Allotted (%)
Unit 1	14 Hrs	20
Unit 2	14 Hrs	24
Unit 3	14 Hrs	20
Unit 4	10 Hrs	16
Unit 5	12 Hrs	20
Total	64	100

Course Code	MAOE301
Course Title	Industrial Mechatronics
Number of Credits	3 (L:3, DCS:1, P:0)
Prerequisites	Engineering Mechanics
Course Category	Open Elective

Course Content:

UNIT-I (14Hrs)

Introduction to Mechatronics: What is mechatronics, The design process Systems, Measurement systems, Control systems, Programmable logic controller, Examples of mechatronic systems.

UNIT-II (11Hrs)

Sensors and signal Conditioning: Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers. Microprocessors, Microcontrollers. PID Controllers and PLCs.

UNIT-III (13Hrs)

Hydraulic Systems: Flow, Pressure and Direction Control Valves. Actuators, Supporting Elements, Hydraulic Power Packs, Pumps. Design of Hydraulic circuits.

UNIT-IV (13Hrs)

Pneumatic System: Production, Distribution and conditioning of compressed air. System Components and Graphic representations. Design of Systems

UNIT-V (13Hrs)

System models: Mathematical models, Mechanical system building blocks, Electrical system building blocks, Fluid system building blocks, Thermal system building blocks

References:

1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton Pearson Education 2019
2. Analysis and design of Dynamic Systems Cochin, Era and Cadwallender, AddisonWesley,1997
3. Mechatronics Engineering Tomkinson, D. And Horne, J. Longman McGraw Hill,1996
4. Mechatronics Bolton, W Pearson
5. Fundamental of mechatronic M. Jouaneh Cengage Learning ISBN –978-1111569020
6. Mechatronics – An Integrated Approach Clarence W. de Silva CRC Press ISBN –978-0849312748

SUGGESTED SOFTWARE/LEARNING WEBSITES:

https://youtu.be/Ro_tFv1iH6g

<https://www.motioncontroltips.com/faq-what-are-stepper-drives-and-how-do-they-work/>

<https://science.howstuffworks.com/robot.htm>

Course outcomes:

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

CO1	Ability to find creative solutions to real life problems using concurrent interdisciplinary approach to engineering design.
CO2	Ability to develop and program advanced manufacturing systems such as CNC machines, rapid prototyping systems and industrial robotics.
CO3	Ability to select appropriate sensors, actuators and control systems depending on application requirement in the domains such as industrial automation, process control, automotive electronics and MEMS.
CO4	Ability to simulate, analyze and design complex interdisciplinary technology systems with embedded software and hardware.

Suggested Distribution of Marks		
Name of Topic /Unit	Time Allotted(Hrs)	Marks Allotted (%)
1	14	20
2	11	20
3	13	20
4	13	20
5	13	20
Total	64	100

Course Code	MAOE302
Course Title	Robotics and Applications
Number of Credits	3 (L: 3, DCS:1, P:0)
Prerequisites	Mechatronics and instrumentation
Course Category	Open Elective

Course Content:

UNIT-I (08Hrs)

Introduction: Robot definition, need, robot terminology, robot motion, robot classification based on physical configuration, advantages and limitations of robot.

UNIT-II (22Hrs)

Basic Elements of Robots: Basic structure, classification of robotic systems- accordingly to types of system, according to control loop, according to structure of manipulator (Cartesian, cylindrical, spherical and articulated). Degree of freedom. End effectors- types, working principle and applications Drives- types and application with working principle. Sensing Devices- optical sensor, proximity sensor- LVDT, Force sensor (strain gauges and piezoelectric), RTD and thermocouple. Motion encoders, Selection Criteria for Robot.

UNIT-III (10Hrs)

Robot controls: Purpose, level of controls; Device controller Work cell controller; Servo and Non-servo control systems – types, basic principle and block diagrams; Working, advantages, limit at ions of some control system; Adaptive control; Computed Torque Technique; New minimum time control; Resolved motion Control

UNIT-IV (12Hrs)

Robot Programming: Need and function of robot programming, Methods; Manual Teaching Lead through Programming languages (VAN, RAIL); Types, features and applications of various programming language

UNIT-V (12Hrs)

Robotic Applications: Material transfer, Machine loading and unloading, painting, packaging, inspection and welding.

Reference:

1. Robotics for Engineers Yoram Koren; McGraw Hill Publisher
2. CAD/CAM/CIM by P. Radhakrishnan and S. Subramaniam; Wiley Eastern Publishers, New Delhi
3. Robotics by K S Fu, R. C. Gonzalez and C S G Lee
4. Robotic Engineering by Richard K Lafter
5. Robot Reliability and Safety by B.S. Dhillon
6. Industrial Robotics by M.P. Groovers et al.

Course Outcome:

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

CO1	Understand the basic concept of robot motion and physical configuration
CO2	Learn the basic structure of robotic system & degree of freedom.
CO3	Use of different types of drives, commissioning of drives and application
CO4	Use different types of industrial sensor to make a live project

Suggested Distribution of Marks		
Name of Topic /Unit	Time Allotted(Hrs)	Marks Allotted (%)
1	08	10
2	22	30
3	10	15
4	12	25
5	12	20
Total	64	100

Course Code	:	MAOE304
Course Title	:	Product Design
Number of Credits	:	3 (L:3, DCS:1, P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

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 Content:

UNIT-I (12Hrs)

Definition of a product; Types of product; Levels of product; Product-market mix; New product development (NPD) process ; Idea generation methods; Creativity; Creative attitude; Creative de-sign process; Morphological analysis; Analysis of interconnected decision are as; Brainstorming.

Unit-II: (12 Hrs)

Product lifecycle; 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: (12Hrs)

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: (16 Hrs)

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; Mathematical modeling; Similitude and scale models; Concurrent design; Six sigma and de-sign for six sigma; Introduction to optimization in design; Economic factors and financial feasibility in design; Design for manufacturing; Rapid Prototyping (RP); Application of RP in product design; Product Development versus Design.

Unit-V: (12 Hrs)

Design of simple products dealing with various aspects of product development; Design starting from need till the manufacture of the product,

Reference Books:

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

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	Describe an engineering design and development process.
CO4	Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO5	Apply modeling and embodiment principles in product design and development process.

Suggested Distribution of Marks

Topic No	Time Allotted (Hrs)	Marks Allotted (%)
1	12	20
2	12	20
3	12	20
4	16	30
5	12	10
Total	64	100

Course Code	:	AGEOE301
Course Title	:	Fertiliser Technology
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

Indian economy dominated by agriculture sector, it is therefore vital for technologists to understand each fertilizer product, its flow sheet diagram for industrial production. For this, student should have skills for arranging treatment, reaction, raw materials for variety of fertilizers including Nitrogenous, Phosphate, Potassic and Bio fertiliser is essential. Hence the course is designed to achieve this objective.

1. Introduction:

Objective, scope and outcome of the course

2. Nitrogenous Fertilisers

Macro and Micro Nutrients, Fertilisers Grades, Various Fertilisers and their demand and production in India, Methods of production of Nitrogenous Fertilisers: Ammonium sulphate, Ammonium nitrate, Urea, Calcium ammonium nitrate, Ammonium chloride. Characteristics, specifications, storage and handling of Nitrogenous Fertilisers.

3. Phosphate Fertiliser

Raw materials; Phosphate rock, Sulphur; Pyrites etc. applications, Processes for the production of Sulphuric and Phosphoric acids. Phosphate Fertilisers –Methods of production of single superphosphate and triple superphosphate. Characteristics and applications.

4. Potassic Fertiliser

Methods of production of Potassium chloride and its application. Potassium schoenite their characteristics and specifications. Complex and NPK Fertilisers Methods of production and applications of Ammonium phosphate sulphate, Diammonium phosphate and various grades of NPK Fertilisers produced in the country.

5. Miscellaneous Fertilisers

Mixed Fertilisers and granulated mixtures; Bio Fertilisers: Need and importance, Vermi-compost preparation and precautions, Method of production of Bio fertiliser using kitchen waste. Initiatives and Scheme of Centre and state Government towards bio fertiliser.

Course outcomes:

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

CO1	Use the proper micronutrients to improve fertility of soil.
CO2	Use relevant fertilizer on the basis of soil .
CO3	Select the relevant manufacturing process for the Phosphatic fertilisers.
CO4	Select the relevant manufacturing process for the Potassic fertilisers.
CO5	Select proper nutrients to produce Bio fertiliser.

Reference Books:

1. Fertilizer Technology and management by Brahma Mishra, Willy Publication.
2. Fertilizer: A Text Book by Ranjan Kumar Basak, Kalynai Publishers.
3. Handbook of Fertilisers - Their Sources, Make-Up Effects and Use by A. F. Gustafson, Read Books
4. Fertilisers and Their Use, 4Th Edition by FAO, Scientific Publishers
5. The Chemistry and Technology of fertilizer by Sauchelli, Reinhold Publication Corp. New York.
6. Bio fertilizers in Agriculture by Rao,N S Subba, Oxford and IBH Publications Co. New Delhi
7. Hand Book fertilizer Technology, Editorial board, The fertilizers association of India, New Delhi

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs.)	Marks Allotted (%)
1	4	5
2	16	25
3	12	20
4	16	25
5	16	25
Total	64	100

Course Code	:	AGEOE302
Course Title	:	Industrial Safety
Number of Credits	:	03(L:03,P:0,DCS:1)
Course Category	:	Open Elective

RATIONALE

To impart knowledge on safety engineering fundamentals and safety management practices.

1. Introduction:

Evolution of modern safety concepts – Fire prevention – Mechanical hazard Boilers, Pressure vessels, Electrical Exposure.

2. Chemical Hazards

Chemical exposure – Toxic materials – Ionizing Radiation and Non-Ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

3. Environmental Control

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

4. Hazard Analysis

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment

5. Safety Regulations

Explosions – Disaster management – catastrophe control, hazard control, Safety education and training - Factories Act, Safety regulations Product safety – case studies

Course outcomes:

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

CO1	Understands the need for safety in various Industrial sectors
CO2	Complete knowledge about various hazards in industries.
CO3	Create and develop innovations in safety.
CO4	Capable of handling various challenges in Industry regarding safety
CO5	Understand the various safety regulations

Reference Books:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. Safety Manual, “EDEL Engineering Consultancy”, 2000.
3. David L.Goetsch, “Occupational Safety and Health for Technologists”, 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.
4. Industrial Safety & Environment by Anupama Prashar , S.K. Kataria & Sons

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs.)	Marks Allotted (%)
1	10	15
2	12	20
3	12	20
4	12	20
5	18	25
Total	64	100

Course Code	:	AGEOE304
Course Title	:	Organic and Natural Farm Practices
Number of Credits	:	03 (L:03, P:00, DCS:1)
Course Category	:	Open Elective

RATIONALE

- To enable the students to learn concept, principles and need of Organic farming.
- To impart the knowledge of selection of Crop, Seed, Soil nutrient management, Harvest management.

1. Introduction

Concept, Philosophies, Principles and Need of organic farming.

2. Package of Practices for organic Farming

Selection of Crop, Seed selection and Treatment, Soil Sampling, Weed Management & Irrigation Management.

3. Soil Nutrient Management

Establishment of Organic Nutrient Production Unit (Manures, Compost and Bio fertilizer) Integrated Pest and Disease Management under Organic Farming including Integrated Pest.

4. Management

Bio pesticides and their Multiplication, Production of Bio and Herbal Pesticides at household/Farm Level.

5. Harvest and Post-Harvest Management

Branding of rural products, FSSAI, marketing and packaging of organic produce. Undertake Business of Organic Farming, Various Current Government schemes related to organic farming & Process of Certification.

Course outcomes:

After completing this course student will be:

CO1	Understand concept, principles and need of Organic farming.
CO2	Distinguish suitable climate for different crops.
CO3	Undertake business of organic farming.
CO4	Understand various Government schemes related to Organic farming and process of certification.

Reference Books:

1. Principles of Organic Farming by P.L. Maliwal Scientific Publishers.
2. Principles of Organic Farming by S.R. Reddy Kalyani Publisher.
3. ABC of Organic Farming by Amitava Rakshit and H B Singh Jain Brothers.
4. Farming System and Sustainable Agriculture by S.R. Reddy Kalyani Publisher.
5. Basics of Organic Farming by Bansal M. CBS Publishers And Distributors Pvt. Ltd.

Suggested Distribution of Marks		
Topic No.	Time Allotted (Hrs.)	Marks Allotted (%)
1	10	15
2	12	20
3	12	20
4	12	20
5	18	25
Total	64	100

Course Code	:	EEVOE 301
Course Title	:	Automotive Fuel and Lubricants
Number of Credits	:	3(L: 3, DCS: 1,P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand the role of various fuel and lubricants
- To understand the properties of various fuel and lubricants
- To understand the testing procedure of various fuel and lubricants

Unit I REFINERY OF FUELS AND LUBRICANTS

Introduction to Structure of petroleum, refining Process-Distillation, cracking processes, Catalytic reforming, alkylation, isomerisation and polymerization, finishing process- blending, products of refining process. Manufacture of lubricating oil base stocks, manufacture of finished automotive lubricants

Unit II_ : THEORY OF LUBRICATION

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

Unit III:-LUBRICANTS

Specific requirements for automotive lubricants, oxidation deterioration and degradation of lubricants, additives and additive mechanism, synthetic lubricants, classification of lubricating oils, properties of lubricating oils, tests on lubricants. Grease, classification, properties, test used in grease- lubricants for gearbox, brake, differential and steering systems

Unit IV:-

PROPERTIES AND TESTING OF FUELS

Properties and testing of fuels- density, calorific value, cetane and octane number, flash point, fire point, distillation, vapour pressure, spontaneous ignition temperature, viscosity, cloud and pour point, flammability, ignitability, diesel index, API gravity, aniline point, carbon residue, copper strip corrosion. Test on used lubricants. Biofuel-properties and testing.

Unit V:- Combustion and Fuel Rating

SI Engines – flame propagation and mechanism of combustion, normal combustion, knocking, octane

rating, fuel requirements. CI Engine, mechanism of combustion, diesel knock, cetane rating , fuel requirements

Text Books:

1. Ganesan.V., “Internal Combustion Engines”, Tata McGraw-Hill Publishing Co., New Delhi
2. Kirpal Singh, “Automobile Engineering Vol-II”, Standard Publishers distributors
3. Mathur.M.L.,Sharma.R.P.“Acoursein internal combustionengines”,Dhanpatraipublication,2003

On completion of this course, a learner should be able to-

CO1	Identify the fuels and lubricants for automotive applications
CO2	Understand the properties of fuels & lubricants and their testing
CO3	Analyze the behavior of fuel and lubricants
CO4	Evaluate the properties and uses of fuel and lubricants
CO5	To understand the combustion process in IC engine

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	13	20
2	13	20
3	13	20
4	13	20
5	12	20
Total	64	100

Course Code	:	EEVOE 302
Course Title	:	Automotive Power Train
Number of Credit	:	3(L: 3, DCS: 1,P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To introduce the various layout of vehicle chassis, engine types.
- To expose the need, constructional details and working principle of various clutches. To envisage the working of manual transmission systems.
- To explicate the operating principle of various automatic transmission systems.
- To relate the importance of driveline components, wheels and tyres.

Unit I Introduction: Layout with reference to power plant. IC Engine operation - classifications and working principle. E – Vehicle layout, operation, advantages and limitations.

Unit II Clutch: Requirements of Transmission system. Purpose and requirement of clutch. Principle of friction clutches. Principle and operation of single plate coil spring and multiplate clutches. Introduction to Electromagnetic clutch.

Unit III Gear Box: Purpose and requirement of gear box. Construction and working principle of sliding mesh and constant mesh gear boxes. Construction and working principle of synchromesh gear box. Introduction to Automated Manual Transmission. Comparison between conventional and Automated Manual Transmission.

Unit IV Automatic Transmission Construction and working principle of Fluid Coupling, advantages and limitations. Construction and working principle of Torque Converter. Multistage and Polyphase Torque converter. Principle of CVT, advantages and limitations.

Unit V Final Drive and Differential: Forces and Torque reaction on rear axle. Propeller shaft, Universal joints. Final Drive and its types. Construction and working principle of Differential. Introduction to Limited Slip Differential. Types of wheels and tyres.

Text Books

1. Rajput R.K., “A Textbook Of Automobile Engineering”, Laxmi Publications; Second edition, 2017.
2. K.Newton, W.Steeds and T.K. Garret, “The Motor Vehicle”, 13th Edition, Butterworth Heinemann, India 2004.
3. William H. Crouse and Donald L. Anglin, “Automotive Mechanics”, 10th Edition, McGrawHill Education, 2017. REFERENCES: 1. David A Crolla, “Automotive Engineering: Powertrain, Chassis System and Vehicle Body”, Butterworth-Heinemann, 2009. 2. Ramalingam K.K, “Automobile Engineering”, Sci-Tec Book, 2005. 3. Heinz Heisler, “Advanced Vehicle Technology”, Butterworth-

Heinemann, 2002.

4. “Bosch Automotive Handbook”, 10th Edition, Robert Bosch GmbH, 2018.

On completion of this course, a learner should be able to:

CO1	Visualize the power flow of various vehicle layouts.
CO2	Understand the working principle the various positive engagement clutches.
CO3	Appraise upon the constructional details and working principle of the manual transmission systems
CO4	Compare and contrast between various automatic transmission systems
CO5	Summarize the significant driveline components, wheels and tyres

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	13	20
2	13	20
3	13	20
4	13	20
5	12	20
Total	64	100

Course Code	:	EEVOE 303
Course Title	:	Basics of Management
Number of Credits	:	3(L: 3, DCS: 1,P: 0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand the basics of management.
- To understand self-management.
- To understand the leadership and motivation.
- To understand the Legal Environment and Business
- To understand the concept of total quality management.

Unit 1: Introduction to Management: Definitions and concept of Management, Functions of management- planning, organizing, staffing, coordinating and controlling, Various areas of management, Structure of an Organization.

Unit 2: Self-Management and Development: Life Long Learning Skills, Concept of Personality Development, Ethics and Moral values, Concept of Physical Development; Significance of health, hygiene, body gestures, Time Management Concept and its importance, Intellectual Development: Reading skills, speaking, listening skills, writing skills (Note taking, rough draft, revision, editing and final drafting), Concept of Critical Thinking and Problem Solving (approaches, steps and cases).

Unit 3: Leadership and Motivation: Meaning, importance , types of leadership and qualities of a good leader. Concept and importance of motivation-drives and incentives, types of motivation.

Unit 4: Legal Environment and Business:

- a) Various labour laws and its necessity. Salient features of Income Tax Act – computation of income tax on salary income, Sales and Excise Tax Act-VAT& Excise duty and Factory Act. 1948.
- b) Labour Welfare Schemes including wage payment-types, system of wage payment and incentives.
- c) Intellectual Property Rights(IPR)- Concepts, infringements and remedies related to patents, copy rights, trademarks and designs.
- d) Accident and Safety- Meaning and concept of accident and safety, causes, safety precautions and various measures after accidents

Unit– 5 Total Quality Management: Meaning and concept of Total Quality Management, various factors/measures to achieve TQM in an organization. Standards and Codes-National & International.

List of Books:

1. Principles of Management by Philip Kotler TEE Publication
2. Principles and Practice of Management by Shyamal Bannerjee: Oxford and IBM Publishing Co, New Delhi.
3. Financial Management by MY Khan and PK Jain, Tata McGraw Hill Publishing Co:: 7, West Patel Nagar , New Delhi.
4. Modern Management Techniques by SL Goel: Deep and Deep Publications Pvt Limited , Rajouri Garden, New Delhi.

On completion of this course, a learner should be able to:

CO1	To understand the basics of management
CO2	To understand self-management
CO3	To understand the leadership and motivation.
CO4	To understand the Legal Environment and Business
CO5	To understand the concept of total quality management.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No.	Time Allotted(Hrs)	Marks Allotted (%)
1	13	20
2	13	20
3	13	20
4	13	20
5	12	20
Total	64	100

Course Code	:	METOE301
Course Title	:	Non Conventional Energy Systems
Number of Credits	:	3 (L:3, DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	OE

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

- Maintain the renewable energy technology equipment.
- To create awareness among the students about the different types of non-conventional energy resources and emphasize its importance.

Course Contents:

Unit – I

(12 Hrs)

Ocean Energy Technologies:

Ocean energy map of India and its implications; Specification, Construction and working of the following ocean energy technologies:

- Tidal power technologies
- Wave power technologies
- Ocean Thermal Energy Conversion (OTEC) technologies

Unit – II

(13 Hrs)

Solar PV and Concentrated Solar Power Plants

- Solar Map of India: Solar PV
- Concentrated Solar Power (CSP) plants, construction and working of Power Tower, Parabolic Trough, Parabolic Dish, Fresnel Reflectors
- Solar Photovoltaic (PV) power plant: components layout, construction, working.

Unit – III

(13 Hrs)

Large Wind Power Plants

Wind Map of India: Wind power density in watts per square meter, Lift and drag principle; long path theory, Geared type wind power plants: components, layout and working, Direct drive type wind power plants: components, layout and working.

Unit– IV

(13 Hrs)

Small Wind Turbines

- Horizontal axis small wind turbine: direct drive type, components and working.
- Horizontal axis small wind turbine: geared type, components and working.
- Vertical axis small wind turbine: direct drive and geared, components and working.
- Types of towers and installation of small wind turbines on roof tops and open fields.

Unit– V

(13 Hrs)

Biomass-based Power Plants

- Types of fuel used for Biomass power plants: Solid, Liquid and gaseous fuels
- Layout of a Bio-chemical based (e.g. biogas) power plant.

- Layout of a Thermo-chemical based (e.g. Municipal waste) power plant.
- Layout of a Agro-chemical based (e.g. bio-diesel) power plant.

Reference Books:

1. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi
2. Neill, Simon P.; Hashemi, M. Reza: Fundamentals of Ocean Renewable Energy: Generating Electricity from the Sea, Academic Press, ISBN:978-0-12-810448-4
3. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd, Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826,
4. Rachel, Sthuthi, Earnest, Joshua; -Wind Power Technologies, PHI Learning, New Delhi, ISBN: 978-93-88028-49- 3; E-book 978-93-88028-50-9
5. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736
6. Gipe, Paul: Wind Energy Basics, Chelsea Green Publishing Co; ISBN: 978-1603580304
7. Wizelius, Tore, Earnest, Joshua - Wind Power Plants and Project Development, PHI Learning, New Delhi, ISBN:978-8120351660
8. Kothari, D.P. et aL: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9
9. Bhadra, S.N., Kasta, D., Banerjee, S, Wind Electrical Systems installation; Oxford University Press, New Delhi, ISBN: 9780195670936.

Course Outcomes:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Maintain ocean thermal energy technologies
- Maintain the optimised working of solar PV and CS power plants.
- Maintain the optimised working of large wind power plants
- Maintain the optimised working of small wind turbines.
- Maintain the optimised working of biomass-based power plants

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	13	12
3	13	12
4	13	12
5	13	12
Total	64	60

Course Code	:	METOE302
Course Title	:	Energy Management
Number of Credits	:	3 (L:3, DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	OE

Course Learning Objectives:

This subject will make the students to learn the following identified competency through various teaching learning experiences:

- To have knowledge about the basic concepts of energy management.
- To apply Energy management concepts while managing the energy intensive utilities.

Course Contents:

Unit – I (12 Hrs)

Energy Sources:

Brief overview of present energy scenario in India, brief overview of share (in %age) of various energy sources in present energy scenario in India , Basic concept and importance of Energy Management.

Unit – II (13 Hrs)

Energy Conservation:

Energy Conservation and its Need Energy Conservation opportunities & energy conversation strategies in domestic sectors; Energy conversation measures in office; Methods/Technologies for Energy Savings in Heating, Ventilating systems and Air Conditioners (HVAC Systems); Energy conversation at macro level

Unit – III (13 Hrs)

Energy Conservation in Industrial Sector:

Introduction; Industrial energy efficiency; Energy saving potential in Industries: Methods/Technologies for energy savings in Furnaces, Ovens, Fans and blowers;
Case studies of energy conservation in Industrial processes

Unit – IV (15 Hrs)

Energy Conservation in Agriculture sector:

Introduction; Energy conservation opportunities in pumps used in agriculture sector; Energy conservation techniques in agriculture sector

Energy Audit:

Need of Energy Audit, Types of Energy Audit: Preliminary Audit, General or Mini audit, and Comprehensive Audit, Energy audit team, Energy Audit methodologies/Procedure.

Unit – V (11 Hrs)

Energy and Environment:

Environment and social concerns related to energy utilization, Environment impact assessment and its need.

RECOMMENDED BOOKS

1. Energy Management by Dr. Umesh Rathore, KATON Publication New Delhi
2. Energy Management by Dr. Sanjeev Singh & Dr. Umesh Rathore, KATON Publication New Delhi
3. Economic Loading of Power Plant and Electric System by M. J. Steinberg and T. H. Smith, John Willey

4. Generation Distribution and Utilization of Electrical Energy by C L Vadhawa, New Age Publication.
5. Study the World Energy Report
6. Study the Energy Audit Reports
7. Manuals of B. E. E (Bureau of Energy Efficiency)

Course outcomes

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

CO1	Understand the fundamentals of energy scenario, energy management, electric energy and economic aspects.
CO2	Understand importance of Energy Conservation in Industrial Sector.
CO3	Understand importance of energy conservation in industrial and agriculture sector.
CO4	Understand needs and type of energy audits.
CO5	Understand Environment and social concerns related to energy utilization.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	10
2	13	13
3	13	13
4	15	14
5	11	10
Total	64	60

Course Code	:	METOE304
Course Title	:	Fundamental of Mechatronics
Number of Credits	:	3 (L:3,DCS:1,P:0)
Prerequisites (Course code)	:	None
Course Category	:	OE

Course Content:

Unit1–Introduction to Mechatronics (12 Hrs)

- Introduction to System Concepts, Analysis and Design
- Mechatronics basic definitions; systems and components;
- Systems with mixed disciplines
- Electronics Fundamentals Review

Unit2– Elements in Mechatronics (13 Hrs)

- Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers
- Microprocessors, Microcontrollers
- PID Controllers and PLCs

Unit3–Drives (13 Hrs)

- Stepper Motors, Servo Drives
- Linear Motion bearings, cams
- Systems controlled by camshafts, electronic cams
- Tool magazines and indexing mechanisms.

Unit4–Hydraulic Systems (13 Hrs)

- Flow, Pressure and Direction Control Valves
- Actuators, Supporting Elements, Hydraulic Power Packs, Pumps
- Design of Hydraulic circuits

Unit5–Pneumatic System (13 Hrs)

- Production, Distribution and conditioning of compressed air
- System Components and Graphic representations
- Design of Systems

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	Analysis and design of Dynamic Systems	Cochin, Eraand Cadwallender	Addison Wesley,1997

2.	Mechatronics Engineering	Tomkinson, D. And Horne, J. Longman	Mc Graw Hill,1996
3.	Mechatronics	Bolton, W	Pearson
4.	Fundamental of mechatronic	M. Jouaneh	Cengage Learning ISBN-978- 1111569020
5.	Mechatronics- An Integrated Approach	Clarence W. deSilva	CRC Press ISBN-978- 0849312748

SUGGESTED SOFTWARE/LEARNING WEBSITES:

1. https://youtu.be/Ro_tFv1iH6g
2. <https://www.motioncontroltips.com/faq-what-are-stepper-drives-and-how-do-they-work/>
3. <https://science.howstuffworks.com/robot.htm>
4. <https://howtomechatronics.com/>

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

CO1	Identify the basic systems and components of mechatronics
CO2	Understand the applications and use of Microprocessors, Microcontrollers and PLCs
CO3	Explain Various kind of drives used in Mechatronics
CO4	Explain System Components and Graphic representations of Pneumatic Systems
CO5	Explain Flow, Pressure and Direction Control Valves used in Hydraulic Systems

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	12	12
2	13	12
3	13	12
4	13	12
5	13	12
Total	64	60

Course Code	:	ME(RAC)OE-301
Course Title	:	Basics of 3D Printing
Number of Credits	:	3 (L:3, DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- Understand the fundamentals of various Additive Manufacturing Technologies. Understand the method of manufacturing of liquid based techniques.
- Understand the method of manufacturing of solid based techniques.
- Understand the method of manufacturing of powder based techniques.

Course Content:

UNIT-I

(14 Hrs)

Introduction and Basic Principles

3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and traditional Machining, Commonly used terms, process chain, 3D modelling, Data Conversion, and transmission, Checking and preparing, Post processing, RP data formats, Classification of 3D Printing Processes.

UNIT-II

(16 Hrs)

Liquid based Systems

Stereo lithography apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages, and disadvantages.

Solid ground curing (SGC): Models and specifications, process, working principle, applications, advantages, and disadvantages.

UNIT-III

(18 Hrs)

Solid Based Systems

Laminated object manufacturing (LOM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages.

Fused Deposition Modeling (FDM): Models and specifications, Process, Working principle, Applications, Advantages and disadvantages.

UNIT-IV**(16 Hrs)****Powder Based Systems**

Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages.

Three dimensional printing (3DP): Models and specification, process, working principle, applications, advantages and disadvantages, case studies.

Reference Books:

1. Chua C.K., Leong K.F. and LIM C.S Rapid prototyping: Principles an Applications, World Scientific publications, 3rdEd., 2010
2. D.T. Pham and S.S. Dimov, “Rapid Manufacturing”, Springer, 2001
3. Terry Wohlers, “ Wholers Report 2000”, Wohlers Associates, 2000
4. Paul F. Jacobs, “ Rapid Prototyping and Manufacturing”–, ASME Press, 1996
5. Ian Gibson, Davin Rosen, Brent Stucker “Additive Manufacturing Technologies, Springer, 2nd Ed, 2014.

Course Outcomes

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

CO1	Understand the fundamentals of Additive Manufacturing Technologies for engineering applications.
CO2	Understand the methodology to manufacture the products using SLA and SGC technologies and study their applications , advantages.
CO3	Understand the methodology to manufacture the products using LOM and FDM technologies and study their applications , advantages.
CO4	Understand the methodology to manufacture the products using SLS and 3D Printing technologies and study their applications , advantages.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	14
2	16	14
3	18	16
4	16	16
Total	64	60

Course Code	:	ME(RAC)OE-302
Course Title	:	Quantitative Techniques for Engineers
Number of Credits	:	3 (L:3, DCS:1 ,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- Understand the basics of statistics.
- Formulate and solve problems on Linear programming.
- Formulate and solve problems on Transportation, and assignment.
- Formulate and solve problems on critical path methods and cost estimation in crashing activities.

Course Content:

UNIT-I (14 Hrs)

Statistics (Simple Numericals)

Mean, Median, Mode, Standard derivation and variance, Averages – Simple average, weighted moving average, Root-Mean Square, Errors – Absolute errors, relative error, percentage errors.

UNIT-II (16 Hrs)

Linear Programming (Simple Numericals)

Introduction, Requirement of LP, Basic Assumptions, Formulation of LP, General Statement of LP, Solution techniques of LP: Graphical Methods, Analytical Methods: Simplex, Introduction of Primal and Dual Problems.

UNIT-III (18 Hrs)

Transportation and Assignment (Simple Numericals)

Transportation Problems definition, Linear form, Solution methods: Northwest corner method, least cost method, Vogel's approximation method. Degeneracy in transportation, Modified Distribution method (MODI method). Assignment Problems-Hungarian method.

UNIT-IV**(16 Hrs)****Project Management (Simple Numericals)**

Introduction to PERT and CPM, Critical Path calculation, float calculation and its importance. Crashing of activities.

Reference Books:

1. Industrial Engineering and Management, O.P .Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi–110002.
2. Operations Research: An Introduction by Hamdy Taha, Pearson Education Inc
3. Operations Research: Principles and Practice by Pradeep PrabhakarPai, Oxford Higher Education, Oxford University press
4. Operations Research: Principles and Practice by Ravindran Phillips and Solberg by Wiley India Edition,
5. Operations Research by P Mariappan, Pearson
6. Operations Research by A M Natarajan, P Balasubramani, A Tamilarasi, Pearson Education Inc
7. Operations Research by H N Wagner, Prentice hall.
8. Optimization in Operations Research by Ronald Rardin, Pearson Education Inc.
9. Operations Research by R. Paneerselvam, Prentice Hall of India Pvt. Ltd.
10. Quantitative Techniques in Management by N D Vohra, Tata McGraw-Hill.

Course Outcomes:-

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

CO1	Understand and apply basics of statistics.
CO2	Make use of LP techniques for optimization.
CO3	Evaluate and solve transportation and assignment problems.
CO4	Solve Project management problems.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	14	14
2	16	14
3	18	16
4	16	16
Total	64	60

Course Code	:	ME(RAC)OE-304
Course Title	:	Solar Thermal Technologies
Number of Credits	:	3 (L:3,DCS:1,P:0)
Prerequisites	:	NIL
Course Category	:	Open Elective

Course Objectives:

- To understand the functioning of various solar thermal collectors.
- To understand the functioning of solar water heating systems.
- To study the various types and configurations of solar space conditioning systems.
- To study the applications of solar thermal technologies in various fields .

Course Content:

UNIT-I (16 Hrs)

Solar Collectors

Introduction, Need of solar collectors, Principle, construction, Working and applications of various Collectors: Flat plate- Water, Air - Evacuated tube, Concentrated –Point Focus, Line Focus and Fresnel lens, Comparison of flat plate and concentrated collectors.

UNIT-II (14 Hrs)

Solar Water Heating Systems

Integral Collector Storage System - Thermosyphon System - Open Loop, Drain Down, Drain Back, Antifreeze Systems - Refrigerant Solar Water Heaters - Solar Heated Pools.

UNIT-III (16 Hrs)

Solar Space Conditioning Systems

Liquid Type Solar Heating System With and Without Storage - Heat Storage Configurations – Heat Delivery Methods - Air-Type Solar Heating Systems, Solar Refrigeration and Air Conditioning

UNIT-IV**(18 Hrs)****Other Solar Technologies**

Principles, Construction, Working and applications of various solar thermal technologies: Solar Cooking, Solar Drying, Distillation, Desalination, Solar Ponds, Solar thermal power generation.

Reference Books:

1. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process - 4 th Edition (2013), John Wiley and Sons, New York, ISBN: 978-0-470-87366-3, Solar Energy Laboratory, University of Wisconsin-Madison, pp. 944.
2. H P Garg, M Dayal, G Furlan, Physics and Technology of Solar Energy- Volume I: Solar Thermal Applications, Springer, 2007.
3. Sukhatme S.P. J K Nayak, Solar Energy, Tata McGraw Hills P Co., ISBN: 9789352607112, 4 th Edition, 2017, pp. 568.
4. Charles Christopher Newton - Concentrated Solar Thermal Energy- Published by VDM Verlag, 2008.
5. H.P.Garg, S.C.Mullick, A.K.Bhargava, D.Reidal, Solar Thermal Energy Storage Springer, 2005.

Course Outcomes:

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

CO1	Explain the technical and physical principles of different solar collectors.
CO2	Measure and evaluate different solar water heating technology through knowledge of the physical function of the devices.
CO3	Measure and evaluate different solar space conditioning technology through knowledge of the physical function of the devices.
CO4	Describe the spectrum of possible solar thermal technologies to assist industrial processing or power production.

SUGGESTED DISTRIBUTION OF MARKS		
Topic No	Time Allotted (Hrs)	Marks Allotted
1	16	14
2	14	12
3	16	16
4	18	18
Total	64	60