MAULANA AZAD NATIONAL URDU UNIVERSITY

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

Accredited 'A' Grade by NAAC

Gachibowli, Hyderabad -500032, T.S.

AICTE Model Curriculum with effect from 2021-22 for MANUU Polytechnics

General Course Structure
&
Credit Distribution

Diploma in
Mechanical Engineering

Definition of Credit:

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

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

B. **Structure of Diploma Engineering Program:**
The structure of Diploma Engineering program shall have essentially the following categories of courses with the breakup of credits as given:

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

C. **Course code and definition:**

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

D. **Course level coding scheme:**

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

E. **Category-wise Courses**

HUMANITIES & SOCIAL SCIENCES COURSES [HS]

Note:

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

(ii) Credits:7

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

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BASIC SCIENCES COURSE [BS]

Note:

(i) Number of Basic Sciences Courses:8

(ii) Credits:18

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

ENGINEERING SCIENCE COURSES [ES]

Note:

(i) Number of Engineering Sciences Courses:8

(ii) Credits:16

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

PROGRAM CORE COURSES [PC]

Note:

(i) Number of Program Core Courses: 20 to 30 (including lab courses)

(ii) Credits:**46**

(iii) Number of contact hours per week of a subject may vary as per subject contents without affecting the subject credits.

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1							
.							
.							
n							
Total Credits							**46**

PROGRAM ELECTIVE COURSES [PE]

Note:

(i) Number of Program Elective Courses: 4 to 6
(Minimum ten Branch Specific courses to be specified for the students to choose from)

(ii) Credits:**12**

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1							
.							
.							
n							
Total Credits							**12**

OPEN ELECTIVE COURSES [OE]

Note:

(i) Number of Open Elective Courses: 3 to 4 (minimum ten courses to be specified out of the suggestive list of open elective courses given as Appendix III)

(ii) Credits:**9**

(iii) The Open Elective Courses to be offered preferably in III year (one course may be offered in V Semester and two courses in VI Semester)

(iv) The students can opt only for those open elective courses that are offered by other than their respective departments

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1							
.							
.							
n							
Total Credits							**9**

PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY OR ELSEWHERE

Sl. No	Code No.	Course Title	Hours per week			Semes-ter	Credits
			L	T	P		
1.		Summer Internship – I (3-4 weeks) after IInd Sem					2
2.		Summer Internship – II (4-6 weeks) after IVth Sem					3
3.		Minor Project	0	0	4	IV	2
4.		Major Project	0	0	2	V	4
5.			0	0	6	VI	
6.		Seminar	1	0	0	VI	1
Total Credits							**12**

Note:

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

AUDIT COURSES [AU]

Note: These are mandatory non-credit courses.

Sl. No	Code No.	Course Title	Hours per week			Semes-ter	Credits
			L	T	P		
1.		Environmental Science	2	0	0	II	0
2.		Essence of Indian Knowledge and Tradition	2	0	0	IV	0
3.		Indian Constitution	2	0	0	VI	0
Total Credits							**0**

DESCRIPTION OF BRANCH CODES

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

INDUCTION PROGRAM

Please refer Appendix IV for guidelines.

The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program ',as available on AICTE Portal, although that is for UG students of Engineering & Technology (Link:https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induction%20program.pdf).

Induction program (mandatory)	Two-week duration
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

F. Mandatory Visits/Workshop/Expert Lectures:

a. It is mandatory to arrange one industrial visit every semester for the students of each branch.

b. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/industry/entrepreneurial orientation.

c. It is mandatory to organize atleast one expert lecture per semester for each branch by inviting resource persons from domain specific industry

G. Evaluation Scheme:

a. For Theory Courses:
(The weightage of Internal assessment is 40% and for End Semester Exam is 60%)
The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

b. For Practical Courses:
(The weightage of Internal assessment is 60% and for End Semester Exam is 40%)
The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

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

Note: The internal assessment is based on the student's performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.

FR (Fail due to shortage of attendance and therefore, to repeat the course)

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Semester I–Pool: 1
(Common to CIVIL, MECH, ECE Branches)
Curriculum Structure

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/week	Scheme of Evaluation		Credits
				L	T	P		CIE	SEE	
1	Basic Science	DPCC113BST	Mathematics-I	2	1	0	3	40	60	**3**
2	Basic Science	DPCC111BST	Applied Physics-I	2	1	0	3	40	60	**3**
3	Basic Science	DPCC112BST	Applied Chemistry	2	1	0	3	40	60	**3**
4	Engineering Science	DPCE111PCP	Engineering Graphics	0	0	2	2	60	40	**1**
5	Basic Science	DPCC112BSP	Applied Chemistry Lab	0	0	2	2	60	40	**1**
6	Engineering Science	DPIT111PCT	Introduction to IT Systems	2	1	0	3	40	60	**3**
7	Engineering Science	DPIT111PCP	Introduction to IT Systems Lab	0	0	4	4	60	40	**2**
8	Basic Science	DPCC111BSP	Applied Physics-I Lab	0	0	2	2	60	40	**1**
9	Humanities& Social Science	CCPE055NCP	Sports and Yoga	0	0	2	2	50	--	**1**
Total Credits										**18**

Semester I- Pool: 2
(Common to CSE, IT, EEE Branches)
Curriculum Structure

Sl. No	Category of Course	Code No.	Course Title	Hours Per week			Total contact hrs/ week	Scheme of Evaluation		Credits
				L	T	P		CIE	SEE	
1	Basic Science	DPCC113BST	Mathematics-I	2	1	0	3	40	60	**3**
2	Basic Science	DPCC111BST	Applied Physics-I	2	1	0	3	40	60	**3**
3	Engineering Science	DPCE101EST	Engineering Mechanics	2	1	0	3	40	60	**3**
4	Humanities & Social Science	DPCC111HST	Communication Skills In English	2	0	0	2	20	30	**2**
5	Engineering Science	DPEE111PCT	Fundamentals of Electrical & Electronics Engineering	2	1	0	3	40	60	**3**
6	Humanities &Social Science	DPCC111HSP	Communication Skills in English Lab	0	0	2	2	60	40	**1**
7	Engineering Science	DPCE112PCP	Engineering Workshop Practice	0	0	4	4	60	40	**2**
8	Basic Science	DPCC111BSP	Applied Physics-I Lab	0	0	2	2	60	40	**1**
9	Engineering Science	DPCE111ESP	Engineering Mechanics Lab	0	0	2	2	60	40	**1**
10	Engine ring Science	DPEE111PCP	Fundamentals of Electrical& Electronics Engineering Lab	0	0	4	4	60	40	**2**
11	Audit	DPCC116NCT	Environmental Science	2	0	0	2	20	30	**0**
	Total Credits									**21**

MANUU Polytechnics **With effect from the academic year 2020-2021**

Semester II–Pool: 1
(Common to CIVIL, MECH, ECE Branches)
Curriculum Structure

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/week	Scheme of Evaluation		Credits
				L	T	P		CIE	SEE	
1	Basic Science	DPCC213BST	Mathematics-II	2	1	0	3	40	60	**3**
2	Basic Science	DPCC211BST	Applied Physics-II	2	1	0	3	40	60	**3**
3	Humanities & Social Science	DPCC111HST	Communication Skills in English	2	0	0	2	20	30	**2**
4	Engineering Science	DPEE111PCT	Fundamentals of Electrical & Electronics Engineering	2	1	0	3	40	60	**3**
5	Engineering Science	DPCE101EST	Engineering Mechanics	2	1	0	3	40	60	**3**
6	Basic Science	DPCC211BSP	Applied Physics-II Lab	0	0	2	2	60	40	**1**
7	Engineering Science	DPCE112PCP	Engineering Workshop Practice	0	0	4	4	60	40	**2**
8	Engineering Science	DPEE111PCP	Fundamentals of Electrical & Electronics Engineering Lab	0	0	4	4	60	40	**2**
9	Engineering Science	DPCE111ESP	Engineering Mechanics Lab	0	0	2	2	60	40	**1**
10	Humanities& Social Science	DPCC111HSP	Communication Skills In English Lab	0	0	2	2	60	40	**1**
11	Audit	DPCC116NCT	Environmental Science	2	0	0	2	20	30	**0**
Total Credits										**21**

Semester II – Pool: 2
(Common to CSE, IT, EEE Branches)
Curriculum Structure

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/week	Scheme of Evaluation		Credits
				L	T	P		CIE	SEE	
1	Basic Science	DPCC213BST	Mathematics-II	2	1	0	3	40	60	**3**
2	Basic Science	DPCC211BST	Applied Physics-II	2	1	0	3	40	60	**3**
3	Engineering Science	DPIT111PCT	Introduction to IT Systems	2	1	0	3	40	60	**3**
4	Engineering Science	DPCE111PCP	Engineering Graphics	0	0	2	2	60	40	**1**
5	Basic Science	DPCC112BST	Applied Chemistry	2	1	0	3	40	60	**3**
6	Basic Science	DPCC211BSP	Applied Physics-II Lab	0	0	2	2	60	40	**1**
7	Engineering Science	DPIT111PCP	Introduction to IT Systems Lab	0	0	4	4	60	40	**2**
8	Basic Science	DPCC112BSP	Applied Chemistry Lab	0	0	2	2	60	40	**1**
9	Humanities &Social Science	CCPE055NCP	Sports and Yoga	0	0	2	2	50	--	**1**
Total Credits										**18**

MANUU Polytechnics **With effect from the academic year 2020-2021**

Mathematics-I

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

Course Content:

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

Differential Calculus

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

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

UNIT - III: Algebra
Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number Addition, Subtraction, Multiplication and Division of a complex number. De-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 and irreducible non-repeated quadratic factors. To resolve improper fraction into partial fraction.
Permutations and Combinations: Value of $n\mathrm{P}_r$ *and* nC_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. A Text book of Engineering Mathematics for I,II semester by Dr. M.V.S.S N. Prasad by Radiant Publishing House.
4. A Text Book of Intermediate, Mathematics I , II year by Telugu Akademi , Telangana
5. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
6. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayanan, Engineering Mathematics, 6/e., Vi-kas Publishing House.
7. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

MANUU Polytechnics **With effect from the academic year 2020-2021**

APPLIED PHYSICS-I

Course Objectives:

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

Learning Outcome:

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

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

Course Content:

Unit 1: Physical world, Units, Dimensions and Vectors

Physics – scope and nature– physics in relation to technology, Physical quantities, Fundamental physical quantities, Derived physical quantities with units, examples. S.I. Units of various physical quantities with symbols, Rules for writing SI units. Dimensions of physical quantity, dimensional formulae, principle of Homogeneity of Dimensions, applications of Dimensional Analysis. Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Resolution of a Vector, Triangle and Parallelogram law of vectors, Scalar and Vector Product, properties with examples, problems solving

Unit 2: Dynamics

Recapitulation of equations of motion in a straight line, acceleration due to gravity, expressions for Maximum Height, Time of ascent, Time of descent and time of flight. Work, energy, power and their SI units, potential Energy and Kinetic Energy examples and their expression. The law of conservation of Energy, verify in the case of freely falling body. simple harmonic motion with examples, conditions of S.H.M, Explanation of simple Harmonic Motion by Reference circle, Expressions for Displacement, Velocity, Acceleration, Time Period and Frequency in S.H.M, simple pendulum and expression for time period of a simple pendulum, second's pendulum, problems solving

Unit 3: Properties of Matter

Introduction to Elasticity, stress and strain, types of stress and strain, Hooke's law moduli of elasticity, young's modulus, Bulk Modulus, Rigidity Modulus. Surface tension: concept, units, cohesive and adhesive forces, angle of contact, applications of surface tension, effect of temperature and impurity on surface tension. Capillarity and its applications in daily life, Experimental determination of surface tension based on capillary rise method. Viscosity and coefficient of viscosity and effect of temperature on viscosity, problems solving

Unit 4: Heat and Thermodynamics

Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), scales of temperature and their relationship, Expansion of solids, coefficient of linear, Areal and cubical expansions and relation amongst them. Expansion of gases, volume coefficient of a gas and pressure coefficient of a gas, Boyles law, Charles laws, ideal gas Equation, laws of thermodynamics, specific heats and molar specific heats, C_P-C_V=R, problems solving.

Text Books and References

1. Concepts of physics by HC VERMA, Surya publication, Ghaziabad, india
2. Physics- Resnik and Halliday- Wiley Toppan Publishers- England
3. Physics- intermediate-I &II year- Telugu Academy, Telangana
4. P.k palaniswamy: Atext book of Engineering Physics
5. C.Kittel(Wiley Eastern) : introduction to solid state physics.

MANUU Polytechnics **With effect from the academic year 2020-2021**

Applied Physics-I Lab

Course Objectives

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

Learning Outcome:

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

- Select right kind of measuring tools (Meter scale, Vernier caliper, Screw gauge, Spherometer etc.) for determining dimensions of physical quantities and make measurements with accuracy and precision.
- Differentiate various shapes and determine dimensions of plane, curved and regular surfac-es/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 viscosity of liquids and determine viscosity of a given liquid.
- Understand use of thermometers to measure temperature under different conditions and different scales of temperature measurements.

List of Practical's

1. Determination of volume of solid cylinder and sphere, using a Vernier caliper
2. Determination of diameter of a wire, thickness of thin glass plate using a screw gauge.
3. Determination of radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.(Concurrent forces)
6. Determination of the acceleration due to gravity at a place using simple pendulum.
7. Determination of force constant of a spring using Hooke's Law.
8. Determination of the surface Tension of a given liquid by capillary Rise Method.
9. Determination of the viscosity of a given liquid by Stoke‟s law
10. Determination of atmospheric pressure at a place using Quill Tube Method
11. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

MANUU Polytechnics **With effect from the academic year 2020-2021**

Applied Chemistry

Course Objectives:

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

Learning Outcomes

At the end of the course student will be able to

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

   b) Understand corrosion and develop economical prevention techniques.

Course Content:

Unit 1: Atomic Structure, Chemical Bonding and Solutions

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

Concept of chemical bonding – cause of chemical bonding, types of bonds: ionic bonding (NaCl example), covalent bond, co-ordination bond in NH_4^+.

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

Unit 2: Water, Chemistry of Fuels and Lubricants

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

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

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

Chemistry of Fuels and Lubricants:

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

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

Lubrication – function and characteristic properties of good lubricant, classification with ex- amples. Physical properties (viscosity and viscosity index, oiliness, flash and fire point, could and pour point only) and chemical properties (coke number, total acid number saponification value)of lubricants.

Unit 3: Engineering Materials

Natural occurrence of metals – minerals, ores of iron, aluminium and copper, gangue (ma-
trix), flux, slag, metallurgy – brief account of general principles of metallurgy.

Extraction of iron from haematite ore using blast furnace. Alloys – definition, purposes of alloying, ferrous alloys and non-ferrous with suitable examples, properties and applications.

Portland cement and hardening, Glasses Refractory and Composite materials.

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

Unit 4: Electro Chemistry

Electronic concept of oxidation, reduction and redox reactions.

Definition of terms: electrolytes, non-electrolytes with suitable examples, Faradays laws of electrolysis and simple numerical problems. Industrial Application of Electrolysis –

- Electrometallurgy
- Electroplating
- Electrolytic refining.

Application of redox reactions in electrochemical cells –

- Primary cells – dry cell,
- Secondary cell-commercially used lead storage battery, fuel and Solar cells. Introduction to Corrosion of metals–
- definition, types of corrosion (chemical and electrochemical), H_2 liberation and O_2 absorption mechanism of electrochemical corrosion, factors affecting rate of corrosion.

Internal corrosion preventive measures –

- Purification, alloying and heat treatment and

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

Suggested Learning Resources:

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

Applied Chemistry Lab

Course Objectives:

There are numerous 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.

Learning Outcomes:

At the end of the course student will be able to

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

LIST OF PRACTICALS:

Perform any 12 (twelve) Laboratory Practicals.

Volumetric and Gravimetric analysis:

1 Preparation of standard solution of oxalic acid or potassium permanganate.
2 To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3 Standardization of $KmnO_4$ solution using standard oxalic acid and Determine the percentage of Iron present in given Hematite ore by $KmnO_4$ solution.
4 Iodometric estimation of copper in the copper pyrite ore.
5 Volumetric estimation of total acid number (TAN) of given oil.
6 Volumetric estimation of
   a) Total hardness of given water sample using standard EDTA solution.
   b) Alkalinity of given water sample using 0.01M sulphuric acid
7 Proximate analysis of coal
   a) Gravimetric estimation moisture in given coal sample
   b) Gravimetric estimation ash in given coal sample

Instrumental analysis

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

Text Book:

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

MANUU Polytechnics **With effect from the academic year 2020-2021**

Communication Skills in English

Course Objectives:

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

To develop confidence in speaking English with correct pronunciation.

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

Course Outcomes:

At the end of this course, the participants will:

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

Course Content

Unit-1 Communication: Theory and Practice

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

Unit-2 Soft Skills for Professional Excellence

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

Unit-3: Reading Comprehension

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

Section-1

Malgudi Days: R.K. Narayan

The Room on Roof: Ruskin Bond "The Gift of the Magi" by *O. Henry*

"Uncle Podger Hangs a Picture" Jerome K. Jerome

Section-2

Night of the Scorpion by Nissim Ezekiel, Stopping by Woods on a Snowy, Evening by Robert Frost, Where the Mind is Without Fear by Rabindranath Tagore, Ode to Tomatoes by Pablo Neruda,

Unit-4: Professional Writing

The art of précis writing, Letters: business and personnel, Drafting e-mail, notices, minutes of a meeting etc Filling-up different forms such as banks and on-line forms for placement etc. Vocabulary and Grammar Vocabulary of commonly used words Glossary of administrative terms (English and Hindi) One-word substitution, Idioms and phrases etc. Parts of speech, active and passive voice, tenses etc., Punctuation

References:

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

MANUU Polytechnics **With effect from the academic year 2020-2021**

Communication Skills in English – Lab

Course Objectives:

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

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

Learning Outcome:

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

Course Content:

Unit 1 Listening Skills

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

Unit II Introduction to Phonetics

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

Unit III Speaking Skills

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

Unit IV Building vocabulary

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

Recommended Readings:

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

MANUU Polytechnics **With effect from the academic year 2020-2021**

Engineering Graphics

Course Objectives:

Following are the objectives of this course:

- *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 Outcomes

Following outcomes will be achieved:

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

Course Content

Unit – I Basic elements of Drawing

- *Drawing Instruments and supporting materials: method to use them with applications. Convention of lines and their applications.*
- *Representative Fractions – reduced, enlarged and full-size scales; Engineering Scales such as plain and diagonal scale.*
- *Dimensioning techniques as per SP-46:2003 – types and applications of chain, parallel and coordinate dimensioning.*
- *Geometrical and Tangency constructions. (Redraw the figure)*

Unit – II Orthographic projections

- *Introduction of projections-orthographic, perspective, isometric and oblique: concept and applications (No question to be asked in examination).*
- *Introduction to orthographic projection, First angle and Third angle method, their symbols.*
- *Conversion of pictorial view into Orthographic Views – object containing plain surfaces, slanting surfaces, slots, ribs, cylindrical surfaces. (use First Angle Projection method only)*
- *Isometric Projections*
- *Introduction to isometric projections. Isometric scale and Natural scale. Isometric view and isometric projection.*
- *Illustrative problems related to objects containing lines, circles and arcs shape only. Conversion of orthographic views into isometric view/projection.*

Unit – III Free Hand Sketches of engineering elements

- *Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, washer, locking arrangements. (For branches other than mechanical Engineering, the teacher should select branch specific elements for free hand sketching)*
- *Free hand sketches of orthographic view (on squared graph paper) and isometric view (on isometric grid paper)*

Unit – IV Computer Aided Drafting Interface & Drafting: concept.

- *Hardware and various CAD software available. System requirements and Understanding the interface.*
- *Components of AutoCAD software window: Title bar, standard tool bar, menu bar, object properties tool bar, draw tool bar, modify tool bar, cursor cross hair. Command window, status bar, drawing area, UCS icon.*
- *File features: New file, Saving the file, opening an existing drawing file, creating templates, Quit.*
- *Setting up new drawing: Units, Limits, Grid, Snap. Undoing and redoing action.*

Computer aided drafting

- *Draw basic entities like Line, Circle, Arc, Polygon, Ellipse, Rectangle, Multiline, PolyLine. Method of Specifying points: Absolute coordinates, Relative Cartesian and Polar coordinates. Modify and edit commands like trim, extend, delete, copy, offset, array, block, layers.*
- *Dimensioning: Linear, Horizontal Vertical, Aligned, Rotated, Baseline, Continuous, Diameter, Radius, Angular Dimensions.*
- *Dim scale variable. Editing dimensions.*
- *Text: Single line Text, Multiline text.*
- *Standard sizes of sheet. Selecting Various plotting parameters such as Paper size, paper units, drawing orientation, plot scale, plot offset, plot area, print preview.*

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. Dream tech Press; Galgotia Publication, New Delhi, 2015; ISBN 978-9351199113.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Environmental Science

Course Objectives:

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

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

Course Outcomes:

At the end of the course student will be able to

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

Course Content:

Pre requisite: - High School Chemistry

Unit-1 Ecosystem

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

Unit– 2 Air and Noise Pollution

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

Unit- 3 Water and Soil Pollution

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

Unit– 4 Renewable sources of Energy

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

References:

Suggested Learning Resources:

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.

MANUU Polytechnics **With effect from the academic year 2020-2021**

Introduction to IT Systems

Course Objectives:

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

Course Outcomes:

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

Course Content:

UNIT 1:

Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals.

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

UNIT 2:

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

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

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

Information security best practices.

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

Suggested Lab Work:

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

References:

1. *R.S. Salaria, Computer Fundamentals, Khanna Publishing House*
2. *Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House*
3. *Online Resources, Linux man pages, Wikipedia*
4. *Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett*

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Introduction to IT Systems Lab

Course Objectives:

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

Course Outcomes:

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

Course Content:

S.No.	Topics for Practice
1	Browser features, browsing, using various search engines, writing search queries
2	Visit various e-governance/Digital India portals, understand their features, services of-fered
3	Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, 27hosal27ze various ports/interfaces and related cables, etc.
4	Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times
5	Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6	Practice HTML commands, try them with various values, make your own Webpage
7	Explore features of Open Office tools, create documents using these features, do it multiple times
8	Explore security features of Operating Systems and Tools, try using them and see what happens.

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

References:

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

MANUU Polytechnics **With effect from the academic year 2020-2021**

Applied Physics –II

Course Objectives

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

Learning Outcome:

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

a) Describe waves and wave motion, periodic and simple harmonic motions and solve simple problems. Establish wave parameters: frequency, amplitude, wavelength, and velocity and able to explain diffraction, interference, polarization of waves.

b) Explain ultrasonic waves and engineering, medical and industrial applications of Ultrasonics. Apply acoustics principles to various types of buildings for best sound effect.

c) State basic optical laws, establish the location of the images formed by mirrors and thin con- verging lens, design and assemble microscope using lenses combination.

d) Describe refractive index of a liquid or a solid and will be able to explain conditions for total internal reflection.

e) Define capacitance and its unit, explain the function of capacitors in simple circuits, and solve simple problems.

f) Differentiate between insulators, conductors and semiconductors, and define the terms: potential, potential difference, electromotive force.

Course Content

UNIT – 1: Wave motion and Optics

Wave motion, transverse and longitudinal waves with examples, progressive and it's characteristics,Sound waves and their properties, principle of superposition of waves and beat formation. Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications. Light waves and their properties, reflection and refraction, refractive index (snell's law), Critical angle, Total internal reflection and conditions for total internal reflection, applications of total internal reflection in optical fiber,. Image formation by thin lenses, lens formula, power of lens, magnification, problems solving

UNIT -2: Electrostatics and Current Electricity

Charges, Coulombs inverse square law, Electric field, Electric lines of force and their properties, Electric potential and potential difference. Capacitance and its units Capacitor and its principle, Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors.

Electric Current and its units, Ohm's law, Resistance and its units, Conductance, Specific resistance, conductivity, Series and parallel combination of resistances. Kirchhoff's laws, Wheatstone bridge and its applications, Meter Bridge Experiment for determination of specific resistance with neat circuit diagram, problems solving.

UNIT – 3: Electromagnetism

Introduction to magnetism, coulomb inverse square law in magnetism, Magnetic field and its units, , magnetic lines of force, Magnetic induction, magnetic moment and units,

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

rectangular coil placed in magnetic field. Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter, problems solving.

UNIT – 4: Modern Physics

Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction diode and V-I characteristics Photo- Electric effect, Einstein's photoelectric equation, laws of photoelectric effect, working of photo cell
Nanoscience and Nanotechnology Introduction, nanoparticles and nanomaterials, properties at nanoscale, nanotechnology and applications, problems solving.

Text Books and References

1. Concepts of physics by HC VERMA, Surya publication, Ghaziabad, India
2. Physics- Resnik and Halliday- Wiley Toppan Publishers- England
3. Physics- intermediate-I &II year- Telugu Academy, Telangana
4. P. K Palani swamy: A text book of Engineering Physics
5. C. Kittel (Wiley Eastern): Introduction to solid state physics.

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Applied Physics Labs –II

Course Objectives:

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

Learning Outcome:

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

a) Apply concept of vibrations and determine the time period of vibrating objects.
b) Use of equipment for determining velocity of ultrasonics in different liquids.
c) Verify optical laws; reflection, refraction from plane interfaces and surfaces.
d) Apply knowledge of optics to determine focal length and magnifying power of optical lenses.
e) Understand uses of electrical components and meters and verify Ohm's law for flow of current.
f) Quantify resistances and verify laws of series and parallel combination of resistances.
g) Measure resistance of a galvanometer and how it is converted into an ammeter and volt-meter.
h) Handle optical fibers and determine numerical aperture of given optical fiber.

List of Practicals/Activities:

1. Determine the Velocity of sound in air using resonance column Apparatus at room temperature and at 0o C.
2. Determine focal length and magnifying power of a convex lens.
3. Determine focal length and magnifying power of a concave lens
4. To verify Ohm"s law by plotting graph between current and potential difference
5. Determine the resistance and specific resistance of the wire using Meter Bridge
6. To verify laws of resistances in series and parallel combination using meter bridge.
7. Draw the lines of force of combined magnetic field due to bar magnet in earth"s magnetic field by locating the null points when North pole of the bar magnet pointing towards Geographical North of the Earth.
8. Draw the lines of force of combined magnetic field due to bar magnet in earth"s magnetic field by locating the null points when North pole of the bar magnet pointing towards Geographical North of the Earth
9. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
10. To measure numerical aperture (NA) of an optical fiber.

Engineering Mechanics

Course Objectives:

Following are the objectives of this course:

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

Course Outcomes:

After completing this course, student will be able to:

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

Course Contents:

Unit – I Basics of mechanics and force system

- Significance and relevance of Mechanics, Applied mechanics, Statics, Dynamics. Space, time, mass, particle, flexible body and rigid body.
- Scalar and vector quantity, Units of measurement (SI units) – Fundamental units and derived units.
- Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.
- Resolution of a force – Orthogonal components of a force, moment of a force, Varignon's Theorem.
- Composition of forces – Resultant, analytical method for determination of resultant for concur- rent, non-concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces.

Unit– II Equilibrium

- Equilibrium and Equilibrant, Free body diagram, Analytical method of analysing equilibrium.
- Lamis Theorem – statement and explanation, Application for various engineering problems.
- Types of beams, supports (hinge, roller and fixed) and loads (vertical, inclined point load & uniformly distributed load) acting on the beam.
- Beam reaction for cantilever, simply supported beam with or without overhang – subjected to Point load, uniformly distributed load and combination of loads.

Unit– III Friction

- Introduction – Theory of Friction – Angle of friction – Laws of Friction – Static and Dynamic Frictions- Wedge Friction, Screw-jack and Differential Screw- jack
- Equilibrium of bodies on level surface subjected to force parallel and inclined to plane.

Unit– IV Centroid

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

Text Book:

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

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Engineering Mechanics Lab

Course Objectives:

Following are the objectives of this course:

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

Course Outcomes:

After completing this course, student will be able to

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

List of Practical to be performed:

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

Text Book:

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

MANUU Polytechnics **With effect from the academic year 2020-2021**

Fundamentals of Electrical and Electronics Engineering

Course Objectives:

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

Outcomes:

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

Course Contents:

UNIT I *Overview of Electronic Components & Signals:*
Passive Components: Resistors, Capacitors, Inductors. Ohm's Law.
Active Components: Diodes and BJT--Construction, Working, Characteristics and Applications.
Signals: DC/AC, voltage/current, periodic/non- periodic signals.

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

Introduction to Boolean Algebra, Simplification of Expressions using Boolean Algebra, Introduction to Logic Gates.

Unit III Electric and Magnetic Circuits
EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, Electromagnetic induction, Faraday's laws of Electromagnetic induction, Lenz's law, Dynamically induced emf, Statically induced emf, Equations of self and mutual inductance; Analogy between electric and magnetic circuits.

Unit IV *A.C. Circuits, Transformers and Machines*
Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor, Peak Factor, impedance, phase angle, and power factor; General Construction and Principle of Transformer; Emf equation and transformation ratio of transformers; Construction and Working principle of DC Motor; Basic equations and characteristic of DC motors.

Text Book:

1. Basic Electrical Engineering, Ritu Sahdev, Khanna Publishing House
2. Electronics Devices& Circuits ,Jacob Millman McGraw Hill Education; 4 edition (2015) ISBN: 978-9339219543

Fundamentals of Electrical and Electronics Engineering Lab

Course Objectives:

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

Course Outcomes:

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

1. Understand basic principle and operation of electric circuits and machines.
2. Solve basic problems related to electrical circuits and machines. Explain the operation of different electrical technologies.
3. Demonstrate an understanding of the control systems.
4. Understand the basic circuit elements
5. Understand different types of signal 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.

S. No.	List of Experiments	Approx. Hrs.
1.	Determine the value of given resistor using digital multimeter to confirm with colour code.	02
2	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	02
3	Use LCR-Q tester to measure the value of given capacitor and inductor.	02
4	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	02
5	Measure voltage, current and power in 1-phase circuit with resistive load.	02
6	Measure voltage, current and power in R-L series circuit.	02
7	Test the performance of PN-junction diode.	02
8	Test the performance of Zener diode.	02
9	Determine the current gain of CE transistor configuration.	03
10	Determine the transformation ratio (K) of 1-phase transformer.	03

Text Book:

1. *Ritu Sahdev, Basic Electrical Engineering, Khanna Publishing House,2018*

MANUU Polytechnics **With effect from the academic year 2020-2021**

Mathematics-II

Course Objectives:

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

Course Content:

UNIT – I: Determinants and Matrices

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

UNIT – II: Integral Calculus

Integration as inverse operation of differentiation. Simple integration by substitution, by parts and by partial fractions (for linear factors only). Use of formulas $\int_0^{\pi/2} \sin^n x\,dx$, $\int_0^{\pi/2} \cos^n x\,dx$ 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, directories or vertices are given.

UNIT – IV: **Vector Algebra**

Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.

UNIT-V: Differential Equations

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

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. A Text book of Engineering Mathematics for I, II, III semester by Dr. M.V.S.S N. Prasad by Radiant Publishing House.
4. A Text Book of Intermediate Mathematics I, II year by Telugu Akademi, Telangana
5. S.S. Sabharwal, Sunita Jain, Eagle Parkashan, Applied Mathematics, Vol. I & II, Jalandhar.

6. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
7. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	**Engineering Workshop Practice**
Number of Credits	:	2 (L: 0, T: 0, P:4)
Prerequisites	:	Nil
Course Category	:	PC

Course Objectives:

Following are the objectives of this course:

- Tounderstandbasicengineeringprocessesformanufacturingandassembly.
- 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
- Tounderstandthevarioustypesofwiringsystemsandacquireskillsinhouse wiring
- To understand, operate, control different machines and equipment's adopting safety practice

Course Outcomes:

After competing this course, student will be able to:

- Acquire skills in basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools &equipment's and machines
- Understandjobdrawingandcompletejobsasperspecificationsinallottedtime
- Inspect the job for the desired dimensions and shape
- Operate, control different machines and equipments adopting safety practices

List of Practicals to be performed (Minimum 8 practicals should be conducted):

S.No.	Details of Practical Content
I	**Carpentry:** i) Demonstration of different wood working processes, like plaining, marking, chiseling, turning of wood etc. ii) One simple job involving any one joint like mortise and tendon dovetail, bridle, half lap etc. **Fitting:** i) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. ii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc.
II	**Welding:** i) Demonstration of different welding tool. Ii) Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint **Sheet Metal Working:** i) Demonstration of different sheet metal operations like sheet cutting, bending, edging, lancing, soldering, and riveting. Ii) One simple job involving sheet metal operations and soldering and riveting
III	**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
IV	**Demonstration:** i) Demonstration of measurement of Current, Voltage, Power and Energy. ii) Demonstration of advance power tools, pneumatic tools, electrical wiring tools and accessories. Iii) Tools for Cutting and drilling

Suggested Learning Resources:

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

MANUU Polytechnics **With effect from the academic year 2020-2021**

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Implementation of AICTE Model Curriculum 2019 for Diploma in Engineering Courses in MANUU Polytechnics (Hyderabad, Bangalore, Darbhanga, Kadapa, Cuttack)

Semester III

Curriculum for Diploma in Mechanical Engineering

S. No	Category	Code No	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Program core course	DPME305PCT	Basic Mechanical Engineering	3	1	0	4	3
2	Program core course	DPME310PCP	Computer Aided Machine Drawing Practice	0	0	4	4	2
3	Program core course	DPME306PCT	Material Science &Engineering	3	0	0	3	3
4	Program core course	DPME307PCT	Fluid Mechanics & Hydraulic Machinery	2	1	0	3	3
5	Program core course	DPME308PCT	Manufacturing Engineering	3	0	0	3	3
6	Program core course	DPME309PCT	Thermal Engineering - I	3	0	0	3	3
7	Program core course	DPME308PCP	Manufacturing Engineering Lab-I	0	0	2	2	1
8	Program core course	DPME307PCP	Fluid Mechanics & Hydraulic Machinery Lab	0	0	2	2	1
9	Program core course	DPME309PCP	Thermal Engineering Lab-I	0	0	2	2	1
10	Summer Intern-ship-1 (4 weeks) after IInd Sem	DPCC310SEP	Internship	0	0	0	0	2
Total				**14**	**2**	**10**	**26**	**22**

MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	BASIC MECHANICAL ENGINEERING
Number of Credits	:	3 (L:3,T: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 outcomes:

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

CO1: Understand the various types of systems in thermodynamics and laws of thermodynamics.

CO2: Understand the mechanism and modes of heat transfer and associated laws.

CO3: Understand application and working of boilers in industries

CO4: Understand preparation of moulds, patterns, various castings defects.

Course Content:

Unit-I: Introduction to Thermodynamics - Role of Thermodynamics in Engineering and Science, Types of System: Open, Closed and Isolated, Types of Properties, Thermodynamic Equilibrium, State, Types of Processes: isobaric, isochoric, Isothermal and adiabatic. Cycle, Elementary introduction to Zeroth, First law for various non-flow and flow processes. Heat and Work Interactions. Steady flow energy equation, SFEE application to nozzle and turbine, Simple numericals related to work done and first law.

Unit-II: Heat transfer: Modes of Heat Transfer; Conduction: Fourier's law, Convection: Newton's law of cooling, Radiation: Stefan Boltzmann's law, application of conduction and convection to Composite Walls. Overall Heat Transfer Co-efficient, Simple Numerical Problems.

Thermal Power Plant: Thermal Power Plant Layout; Fire Tube and Water Tube boiler, Babcock & Wilcox boiler. Basic principle of Impulse and Reaction Turbines; Examples, Condensers: Surface Condensers, Cooling Towers: Natural, Draft cooling tower.

Unit-III: Materials and Manufacturing Processes: Engineering Materials, Classification and their Properties; Basic Manufacturing Processes and their characteristics. Casting Processes: Introduction, Advantages and Limitations, Applications, Casting Terms, Sand Mould making procedure. Pattern-materials, types, allowances. Moulding sands, properties of moulding sands, core sands, gating systems and their types, functions of risers. Die casting, centrifugal casting, Investment casting. Casting defects, causes and remedies.

Unit-IV: Forming Processes: Plastic deformation, Hot working and Cold working. Rolling: Principle, Rolling Load, Rolling Passes, Breakdown Passes, Roll Pass Sequence types of roll mills.

Forging: Smith forging, Drop Forging, Press forging, Machine forging. Hot Extrusion, Cold extrusion, extrusion tubes, Wire drawing, Rod and Tube drawing, Deep drawing and spinning.

Reference Books:

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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	Computer Aided Machine Drawing Practice
Number of Credits	:	2 (L:0,T: 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 Outcomes:

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

CO1: Understand the representation of materials used in machine drawing

CO2: Draw the development of surfaces for sheet metal working applications.

CO3: Draw the machine elements including keys, couplings, cotters, riveted, bolted and welded joints.

CO4: Construct an assembly drawing using part drawings of machine components, represent tolerances and the levels of surface finish on these components.

Course Content:

Unit-I: Introduction to CAD software.

Unit-II: Drawing aids and editing commands.

Unit-III: Basic dimensioning, hatching, blocks and views. Isometric drawing, printing and plotting.

Unit-IV: Machine Drawing practice using Auto CAD: Detailed drawings of following machine parts are to be given to the students to draw the sectional or plain elevations, plans and side views with dimensioning and bill of materials using cad software (12 exercises).

1) Sleeve & Cotter Joint 2) Spigot & Cotter Joint 3) Knuckle Joint 4) Stuffing Box 5) Screw Jack 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 book

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 Company, New Delhi, 2000.
3. Kannaih, P., Production Drawing, New Age International, 2009.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	Material Science & Engineering
Number of Credits	:	3 (L:3,T:0,P: 0)
Prerequisites	:	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.

Course Outcomes:

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

CO1: Explain about crystal structures and atomic bonds.

CO2: Describe about classification of ferrous metals and their properties.

CO3: Explain about non-ferrous metals, cutting tool materials and composites along with their properties.

CO4: Describe about the various metallic failures and knowledge in testing of

Course Content:

Unit-I: Crystal structures and Bonds: Unit cell and space lattice: Crystal system: The seven basic crystal systems; Crystal structure for BCC, FCC and HCP; Coordination number for Simple Cubic, BCC and FCC; Atomic radius: definition, atomic radius for Simple Cubic, BCC and FCC; Atomic Packing Factor for Simple Cubic, BCC, FCC and HCP; Simple problems on finding number of atoms for a unit cell. Bonds in solids: Classification – primary and secondary bonds. Ionic, Covalent and Metallic Bonds; Dispersion bond, Dipole bond and Hydrogen bond.

Unit-II: Phase diagrams, Ferrous metals and its Alloys: Isomorphs, eutectic and eutectoid systems; Iron-Carbon diagram; Iron and Carbon Steels. Classification, composition, uses of Pig iron, Cast Iron and Wrought Iron, Effects of impurities on iron. comparison of cast iron, wrought iron and mild steel and high carbon steel; standard commercial grades of steel as per BIS and AISI; Alloy Steels – purpose of alloying; effects of alloying elements. High Speed Steel (HSS), spring steel, Stainless Steel (SS): types and, applications of SS.

Unit-III: Non-ferrous metals and its Alloys: Properties and uses of aluminium, copper, tin, lead, zinc, magnesium and nickel; Copper alloys: Brasses, bronzes – composition, properties and uses; Aluminum alloys: Duralumin, Hindalium, magnalium – composition, properties and uses; Anti-friction/Bearing alloys: Various types of bearing bronzes.

Unit-IV: Failure analysis & Testing of Materials: Introduction to failure analysis; Fracture: ductile fracture, brittle fracture; fatigue; endurance limit; characteristics of fatigue fracture; 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.
Surface Engineering: Surface engineering processes: Coatings and surface treatments; Cleaning and mechanical finishing of surfaces; Organic coatings; Electro polishing and photo-etching, thin film coatings: PVD and CVD.

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.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	Fluid Mechanics & Hydraulic Machinery
Number of Credits	:	3 (L:2,T:1,P: 0)
Prerequisites	:	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 analyse the performance of pumps and turbines.

Course Outcome:

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

CO1**:** Measure various properties such as pressure, velocity, flow rate using various instruments.

CO2: Calculate different parameters such as co-efficient of friction, power, efficiency etc of various Systems.

CO3: Describe the construction and working of turbines and pumps.

CO4: Test the performance of turbines and pumps.

Course Content:

Unit-I: 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, Bourdon pressure gauge, Simple problems on manometers.

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

Flow Through Pipes: Laminar and turbulent flows, losses due to: enlargement, contraction, obstruction and bends in pipes, simple numerical problems.

Unit-III: Impact of jets: Impact of jet on fixed vertical, moving vertical flat plate, Impact of jet on curved vanes with special reference to turbines & pumps, Simple Numericals on work done and efficiency.

Hydraulic Turbines: Layout of hydroelectric power plant, classification of hydraulic turbines, Selection of turbine based on head and discharge available, construction & working principle of Pelton wheel, Francis and Kaplan turbines, draft tubes and its functions, Concept of cavitation in turbines, calculation of Work done, power, efficiency of turbines, simple numericals.

Unit-IV: Centrifugal Pumps: Principle of working and applications, Types of casings and impellers, Concept of multistage, Priming and its methods, Cavitation, Manometric head, Work done, Manometric efficiency, Overall efficiency. Numericals on overall efficiency and power required to drive pumps.

Reciprocating Pumps: Construction, working principle and applications of single and double acting reciprocating pumps Concept of Slip.

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. New Delhi.
4. One Thousand Solved Problems in Fluid Mechanics – K. Subramanya, Tata McGraw Hill.
5. Fluid Mechanics and Hydraulic Machines – R. K. Bansal, Laxmi Publications, New Delhi.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

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

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Course Objectives:

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

Course Outcomes:

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

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

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

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

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

Course Content:

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

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

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

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

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

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

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

Reference Books:

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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	Thermal Engineering - I
Number of Credits	:	3 (L: 3,T: 0,P: 0)
Prerequisites	:	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.
- 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 study and apply pinch technology and to critically analyze and describe the global behaviour of integrated thermal systems.

Course Outcomes:

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

CO1: Know various sources of Energy and their applications.
CO2: Classify I.C. engines and understand their working and constructional features.
CO3: Draw the energy flow diagram of an I.C. engine and evaluate its performance.
CO4: Describe the constructional features of air compressor, working of refrigeration and classify air-conditioning systems.

Course Content:

Unit-I: Kelvin-Planck and Clausius statements of 2nd Law of Thermodynamics, Concept of Heat Engine, Heat Pump & Refrigerator, Efficiency/ COP; Concept of Entropy, Carnot Cycle, T-s and P-V Diagrams, Carnot theorem.
Air standard cycle: Assumptions, working of Otto and Diesel cycles with P-V and T-s diagrams.
Vapor power cycle: Rankine cycle with T-s and h-s diagrams.

Unit-II: Internal and external combustion engines: Advantages of I.C. engines over external combustion engines; classification of I.C. engines; neat sketch of I.C. engine indicating components, Function of each part and materials used for the components - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, fins, cylinder heads, exhaust valve, inlet valve; Working of two stroke and four stroke engines; Working of four-stroke petrol and diesel engines, Valve timing and port timing diagrams for four stroke and two stroke engines.

Unit-III: Carburetion, cooling ignition and lubricating systems Principle of operation of simple and Zenith Carburettor. Fuel system of Diesel engines; Types of injectors and fuel pumps; Cooling system - air-cooling, water-cooling system with thermo siphon method of circulation, water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water-cooling system; Ignition systems, Types of lubricating systems used in I.C. engines with line diagram; Objective of super charging.

Unit-IV: 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; Methods of determination of B.P, I.P and F.P.; Simple numerical problems on performance of I.C engines.

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) using P-V diagram; Multi stage compressors - Advantages over single stage compressors.

Reference Books:

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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

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

Course Objectives:

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

Course Outcome:

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

CO1: Prepare a mould sand mix and molten metal and calculate the amount of metal to be poured in the mould

CO2: Centre the job and select the proper tool to perform the job on lathe machine.

CO3: Calculate the taper angle and practice different taper turning methods on lathe.

CO4:Prepare the edges for welding and select the suitable electrode, voltage and current.

Cycle-I

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

Cycle -II

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

Reference Books:

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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	Fluid Mechanics & Hydraulic Machinery Lab
Number of Credits	:	1 (L: 0,T: 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 outcomes:

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

CO1: Measure various properties such as pressure, velocity, flow rate using various instruments.

CO2: Calculate different parameters such as co-efficient of friction, power, efficiency etc. of various systems.

CO3: Understand the need and importance of calibration of pressure gauges.

CO4: Describe the construction and working and test the performance of turbines and pumps.

Cycle I

1. Verification of Bernoulli's theorem.
2. Determination of Coefficient of Discharge of Venturi meter.
3. Determination of Coefficient of Discharge, coefficient of contraction and coefficient of
4. velocity of Orifice meter.
5. Determination of coefficient of friction of flow through pipes.
6. Determination of force exerted by the jet of water on the given vane.

Cycle II

1. Determination of minor losses of flow through pipes.
2. Calibration of pressure gauge using dead weight pressure gauge tester.
3. Trial on centrifugal pump to determine overall efficiency.
4. Trial on reciprocating pump to determine overall efficiency.
5. Trial on Pelton wheel to determine overall efficiency.
6. Trial on Francis/Kaplan turbine to determine overall efficiency.

Reference Books:

1. N. Kumara Swamy, Fluid Mechanics and Machinery Laboratory Manual, Charotar Publishing House Pvt. Ltd., Anand 388 001, Ed. 2008.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

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

Course Objectives:

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

Course Outcomes:

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

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

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

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

Cycle I

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

Cycle II

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

Reference Books:

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

Implementation of AICTE Model Curriculum 2019 for Diploma in Engineering Courses in MANUU Polytechnics (Hyderabad, Bangalore, Darbhanga, Kadapa, Cuttack)

Semester IV

Curriculum for Diploma in Mechanical Engineering

Sl. No	Category	Code No	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Program core course		Measurements & Metrology	2	1	0	3	3
2	Program core course		Strength of Materials	2	1	0	3	3
3	Program core course		Thermal Engineering – II	2	1	0	3	3
4	Program Elective course–1 (PE1)		Program Elective – 1	3	0	0	3	3
5	Program Elective course–2 (PE2)		Program Elective – 2	3	0	0	3	3
6	Program core course		Material Testing Lab	0	0	3	3	1
7	Program core course		Measurements & Merilogy Lab	0	0	2	2	1
8	Program core course		Thermal Engineering Lab-II	0	0	3	3	1
9	Minor Project			0	0	4	4	2
10	Mandatory Course		Essence of Indian Knowledge and Tradition	2	0	0	2	0
Total								**20**

Program Elective – 1:

1. Automobile Engineering
2. Heat Transfer
3. Farm Equipment & Farm Machinery

Program Elective -2:

1. Computer Aided Design and Manufacturing
2. Tool Engineering
3. Computer Integrated Manufacturing

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	MEASUREMENTS & METROLOGY
Number of Credits	:	3 (L: 2, T: 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 outcomes

CO1: Define accuracy, precision, calibration, sensitivity, repeatability and such relevant terms in metrology.

CO2: Understand the principle of operation of instruments and transducers and select suitable measuring device for a particular application.

CO3: Understand the principles of measurement of displacement, speed, force, pressure and torque.

CO4: Understand the concept of limits, fits and design the gauges using Taylor's principle.

Course Content:

UNIT-I: Introduction to measurements: Definition of measurement; Significance of measurement; Methods of measurements: Direct & Indirect, Contact & Non-Contact; Generalized measuring system; Standards of measurements; Factors influencing selection of measuring instruments; Terminology: Precision, Accuracy, Sensitivity, Repeatability, Range, Threshold, Hysteresis, calibration; Errors in Measurements: Classification of errors, Systematic and Random errors.

Measuring Instruments: Linear measurement: Principle and applications of Vernier Calipers, Micrometers; Types of micrometers: Outside, Inside, Depth and Thread micrometer; Vernier height gauge; Angular measurements: Universal Bevel protractor, Sine Bar and Angle gauges; Comparators: Characteristics of comparators, Types of comparators.

Unit-II: Transducers and Strain gauges: Introduction, Transducers: Characteristics, classification of transducers, two coil self-inductance transducer, Piezoelectric transducer;

Strain Measurement: Strain gauge, Classification, Strain gauge sensitivity, mounting of strain gauges, Strain gauge rosettes-two and three elements.

Measurement of force, torque, and pressure: Introduction; Force measurement: Spring Balance, Proving ring, Load cell; Torque measurement: Prony brake, Eddy current and Hydraulic dynamometers; Pressure measurement: McLeod gauge.

Unit-III: Applied mechanical measurements: Displacement measurement: Linear variable Differential transformers (LVDT); Speed measurement: Classification of tachometers, Revolution counters, Eddy current tachometers; Flow measurement: Rotameter, Turbine meter; Temperature measurement: Resistance thermometers, Optical Pyrometer, Biomedical measurement: Sphygmomanometer. Surface finish: Definition, Terminology of surface finish: Roughness, waviness, Lay; measurement using Talysurf; Co-ordinate measuring machine.

Unit-IV: Limits, Fits & Tolerances: Limits, Fits & Tolerances: Concept of Limits, Fits, Tolerances and their grades; Selective Assembly; Interchangeability; Hole and Shaft Basis System; Taylor's Principle; Design of Plug; Ring Gauges; IS 919-1993 (Limits, Fits & Tolerances, Gauges)

IS 3477-1973;

Screw thread Measurements: ISO grades, Errors in threads; Pitch errors; Measurement of major diameter, minor diameter, effective diameter, pitch of external threads; Two wire method.

Gear Measurement and Testing: Analytical and functional inspection; Measurement of tooth thickness (constant chord method); Gear tooth Vernier; Rolling test; Backlash Error.

Machine tool testing: Parallelism, Straightness, Squareness, Co-axiality, roundness, run out and alignment testing of Lathe as per IS standard procedure.

Reference Books:

1. Mechanical measurements – Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Metrology & Measurement – Anand K Bewoor,Vinaykulakarni, Tata McGraw Hill, New Delhi, 2009.
3. Principles of Industrial instrumentation and control systems –Channakesava. R. Alavala, DELMAR cenage learning, 2009.
4. Principles of Engineering Metrology –Rega Rajendra, Jaico publishers, 2008.
5. Dimensional Metrology – Connie Dotson, DELMAR, Cenage learning, 2007.
6. Instrumentation measurement and analysis – B.C. Nakara, K.K. Chaudary, second edition, Tata Mcgraw 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, ELBS.
10. Engineering Metrology – K. J. Hume, Kalyani publishers.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

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

Course Objectives:

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

Course outcomes:

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

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

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

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

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

Course content

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

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

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

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

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

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

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

Reference Books:

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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	THERMAL ENGINEERING - II
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	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 Outcomes

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

CO1: 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.

CO2: Compute the work done, enthalpy, internal energy and entropy of steam at given condition using steam tables and Mollier chart.

CO3: Distinguish between water tube and fire-tube boilers and explain the function all the mountings and accessories.

CO4: Explain the principle of working of a steam turbine, calculation of steam velocity at the exit of nozzle in terms of heat drop analytically and by using Mollier chart

Course content

Unit-I: Properties of Steam: Formation of steam under constant pressure; Industrial uses of steam; Basic definitions: saturated liquid and saturated vapor lines, liquid, wet and superheat regions, critical point, saturation temperature, sensible heat, latent heat, wet steam, dryness fraction, saturated and superheated steam, degree of superheat.

Determination of enthalpy, internal energy, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart for the following processes: Isochoric process, Isobaric process, Isothermal process, Isentropic process, throttling process, Simple direct problems; Steam calorimeters: Separating, throttling, and throttling calorimeters.

Unit-II: Steam Generators: Function and use of steam boilers; Classification of steam boilers with examples; Comparison of water tube and fire tube boilers; Brief explanation with line sketches of Cochran boiler, 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 and it's types; Boiler accessories: feed pump, economiser, super heater and air pre-heater; Study of steam traps & separators; Boiler horse power and boiler efficiency; Formula for the above terms without proof; Simple direct problems; Draught systems (Natural, forced & induced).

Unit-III: Steam Nozzles: Flow of steam through nozzle; Velocity of steam at the exit of nozzle in

terms of heat drop 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; Super saturated flow in nozzles; Working steam jet injector; Simple numerical problems.

Steam Turbines: Classification of steam turbines with examples; Comparison of impulse & reaction turbines; Principle of working of a simple De-lavel turbine with line diagrams- Velocity diagrams; Expression for work done, blade and diagram efficiency, stage efficiency, nozzle efficiency; 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; Simple problems on single stage impulse turbines (without blade friction) and reaction turbine.

Unit-IV: Gas Turbines: Air-standard Brayton cycle; Description 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 lay-out of Open and Closed cycle gas turbine; P-V and T-S diagrams and working.

Jet Propulsion: Principle of jet propulsion; Fuels used for jet propulsion; Applications of jet propulsion; Working of a turbojet engine; Principle of Ram effect; Working of a Ram jet engine; Principle of Rocket propulsion; Working principle of a rocket engine; Applications of rocket propulsion; Comparison of jet and rocket propulsions.

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 New Delhi
3. Thermal Engineering – P.L. Ballaney, Khanna Publishers, 2002
4. Treatise on Heat Engineering in MKS and SI Units – V.P. Vasandani& D.S. Kumar, Metropolitan Book Co. Pvt. Ltd, New Delhi.

MANUU Polytechnics **With effect from the academic year 2020-2021**

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

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 outcomes

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

CO1: Identify the components of an automobile with their working.
CO2: Explain the concepts of cooling and lubricating systems.
CO3: Explain the concepts of Ignition and Transmission and steering systems.
CO4: Identify different suspension systems and their applications.

Course Content:

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

Unit-II: 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: 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.

Unit-III: Ignition system and transmission 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 and constant mesh gear box; Working of propeller shaft, universal joint; Types of rear axle; Purpose of front axle.

Unit-IV: Steering and Suspension system: Steering system and its importance; Caster, camber and king pin inclination; Rack and pinion steering system; Power steering.

Necessity of suspension system; Torsion bar suspension systems; Leaf spring and coil spring

suspension system; Independent suspension for front wheel and rear wheel; Functions of brakes; Types of brakes.

Reference Books:

1. Automobile Engineering Vol I, 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 Vol I and Vol II, K. M. Gupta, Umesh Publications.
6. Automotive Engineering, Jain and Asthana, Tata McGraw Hill.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	HEAT TRANSFER
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Basic Mechanical Engineering
Course Category	:	PE

Course Objectives:

- To understand the concepts of conduction.
- To understand the concepts of convection.
- To understand the concepts of Fins heat transfer.
- To understand the basics of heat exchangers.
- To understand the concepts of radiation.

Course outcomes:

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

CO1: Understand the concepts of conduction.
CO2: Understand the concepts of convection.
CO3: Understand the basic concepts of fins and heat exchangers.
CO4: Understand the concepts of radiation.

Course Content:

UNIT-I: Conduction: Derivation of the energy equation in three dimensions including transient effect; Thermal diffusivity and Fourier number; Types of boundary conditions, One dimensional solution with and without heat generation; Analogy with electrical circuits; Simple problems.
Lumped parameter approach and physical significance of time constant, Validity of lumped parameter approach. Biot number, Introduction to Heisler Chart.

UNIT-II: Convection: Introduction, Forced convection, Velocity and thermal boundary layer over a flat plate, Momentum and energy equations in two dimensions, Non-dimensionalization, importance of non-dimensional quantities and their physical significance, Analogies between momentum, heat and mass transfer; Reynolds-Colburn analogy. Natural Convection, Physical Mechanism of Natural Convection, Grashof number.

UNIT-III: Fins: Rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation.
Heat exchangers: Types of heat exchangers, parallel and counter flow types, Introduction to LMTD; Correction factors, fouling factor; NTU method, Simple problems on LMTD.

UNIT-IV: Radiation: Physical mechanism of thermal radiation, laws of radiation, definition of black body, emissive power, intensity of radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity. Radiation exchange between black bodies, geometric configuration factor (no derivation), concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces by radiation network. Radiation shielding.

Reference Books:

1. Fundamentals of Heat and Mass Transfer by F. P. Incropera and D. P. Dewitt, 4th ed., John Wiley & Sons.
2. Heat and Mass Transfer by D. S. Kumar, S. K. Kataria& Sons, 2009.
3. Heat Transfer - A Basic Approach by M. N. Ozisik, Mc Grawhill.

4. Heat Transfer by J. P. Holman, 8th ed., Mc Grawhill.
5. Elements of Heat & Mass Transfer by Vijay Gupta, 2nd ed., New Age International Publishers.
6. Heat transfer: A practical approach by Cengel&Yunus, 2nd ed., TMH.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	COMPUTER AIDED DESIGN AND MANUFACTURING
Number of Credits	:	3(L: 3, T: 0, 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 modelling using CAD.
- To understand the need for integration of CAD and CAM.
- To understand the concepts of flexible manufacturing system.

Course outcomes:

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

CO1: Develop mathematical models to represent curves and surfaces and Model engineering components using solid modeling techniques.

CO2: Understand geometric transformation techniques in CAD.

CO3: Develop programs for CNC to manufacture industrial components.

CO4: Understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

Course Content:

UNIT-I: Fundamentals of CAD/CAM: Automation; Design process; Application of computers for design; Benefits of CAD; Computer configuration for CAD applications; Design 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; Curve fitting techniques.

Unit-II: Surface Modeling: Algebraic and Geometric form; Parametric space of surface; Blending functions; Parametrization of surface patch; Subdividing; Cylindrical surface; Ruled surface; Surface of revolution; Spherical surface; Composite surface; Bezier surface; Solid Modeling; Sweep representation; Constructive solid geometry; Boundary representations.

Unit-III: 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; Post processor; G and M code, Computerized part program.

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

Flexible manufacturing system: F.M.S equipment; Layouts; Analysis methods and benefits; Computer aided quality control; Automated inspection: Off-line, On-line, 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.
4. Computer Integrated Manufacturing - Paul G. Rankey, Prentice Hall.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	TOOL ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, 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 outcomes:

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

CO1: Understand concepts, principles and procedures of tool engineering.
CO2: Classify and explain various tools and tool operations.
CO3: Select proper tool and a die for a given manufacturing operation to achieve highest productivity.
CO4: Estimate tool wear and tool life and fundamentals of tools.

Course Content:

UNIT-I: 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 and form cutting, Methods of taper turning.

Cutting fluids: types; characteristics and applications.

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

Unit-II: Machinability: Definition; factors affecting machinability; machinability index.

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

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

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

Punch & Die mountings: pilots; strippers; misfeed detectors; Pressure Pads; Knock outs; stock guide; Feed-Stop; guide bush; guide pins.

Die Design Fundamentals: Die Operations; blanking; piercing; shearing; cropping; notching; lancing; coining; embossing; stamping; curling; drawing; bending; forming; Die set; Die shoe; Die area; Calculation of clearances on die and punch for blanking and piercing dies.

Unit-IV: Forming Dies: Bending methods; Bending Dies; bend allowance; spring back; spanking; bending pressure; pressure pads; development of blank length.

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 and forging dies.

Reference Books:

1. Tool Design - Donaldson Anglin, Tata McGraw Hill.
2. Tool Engineering and Design GR Nagpal, Khanna publisher.
3. Production Technology- H.M.TJain, Tata McGraw Hill.
4. A Text Book of Production engineering - P.C. Sharma, S.Chand& Co.
5. Production Technology, R.KJain, Khanna Publishers.

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	MATERIAL TESTING LAB
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	Material Science & Engineering
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 outcomes

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

CO1: Identify the given specimen by viewing the micro structure 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 shear values, modulus of rigidity, strain energy, shear stress and stiffness of coil spring of given materials

Cycle I

1. Prepare a specimen and examine the microstructure of the Ferrous and Non- ferrous metals using the Metallurgical Microscope.
2. Detect the cracks in the specimen using (i) Visual inspection and ring test (ii) Die penetration test (iii) Magnetic particle test.
3. Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum.
4. Finding the resistance of materials to impact loads by Izod test and Charpy test.

Cycle II

1. Torsion test on mild steel – relation between torque and angle of twist determination of shear modulus and shear stress.
2. Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
3. Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open & Closed coil spring)
4. 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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	MEASUREMENTS & METROLOGY LAB
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites	:	Measurements & Metrology (MEPC202)
Course Category	:	PC

Course Objectives:
To understand techniques for precise measurement of the dimensions of various objects and shapes.

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

CO1: Measure various component of linear measurement using Vernier calipers and Micrometer.
CO2: Measure various component of angle measurement using sine bar and bevel Protractor
CO3: Measure the geometrical dimensions of V-thread and spur gear
CO4: Perform alignment tests on Lathe machine.

I Cycle

1. Measure the dimensions of ground MS flat/cylindrical bush using Vernier Caliper compare with Digital/Dial Vernier Caliper.
2. Measure the diameter of a wire using micrometer and compare the result with digital micrometer.
3. Measure the bore diameter and depth of bore of the given specimen using inside and depth micrometer.
4. Measure the height of the given specimen using Vernier height gauge.

II Cycle

1. Measure the angle of a V-block / Taper Shank of Drill / Dovetail using universal bevel protractor.
2. Measure the angle of the machined surface using sine bar and slip gauges.
3. Measure the geometrical dimensions of V-Thread using thread Vernier gauge.
4. Measure the thickness of ground MS plates using slip gauges.
5. Alignment tests on Lathe machine.

Reference Books:

1. Engineering Metrology – R. K. Jain
2. Engineering precision metrology – R. C. Gupta
3. A Hand book of Industrial Metrology – ASME

MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	
Course Title	:	THERMAL ENGINEERING LAB-II
Number of Credits	:	1.5 (L: 0, T: 0, P: 3)
Prerequisites	:	Thermal Engineering – I and 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 understand economical and optimum running conditions of the engines.

Course outcomes:

CO1: Evaluate the performance characteristics of single cylinder diesel/petrol engine at different loads and draw the heat balance sheet.
CO2: Find the indicated power of individual cylinders of an engine by using morse test.
CO3: Evaluate the performance characteristics Multi stage air compressor
CO4: Evaluate the co efficient of performance of refrigerator.

Cycle I

1. Study of high-pressure boiler with model
2. Study of boiler mountings and accessories
3. Conduct performance test on VCR test rig to determine COP of the refrigerator
4. Conduct performance test on multi stage reciprocating compressor
5. Conduct Morse test to determine the indicated power of individual cylinders.

Cycle II

1. Conduct Performance test on 2-S CI/SI engine.
2. Conduct Performance test on 4-S CI/SI engine.
3. Conduct Heat balance test on CI/SI engine.
4. Conduct Economical speed test on 4-S CI/SI engine.
5. Thermal conductivity test on 1) Thick slab 2) Composite wall 3) Thick cylinder

Reference Books:

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

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MANUU Polytechnics **With effect from the academic year 2020-2021**

Course Code	:	**DPCC401PET**
Course Title	:	**Essence of Indian Knowledge and Tradition**
Number of Credits	:	0 (L: 2, T: 0, P:0)
Prerequisites	:	Nil
Course Category	:	AU

Learning Outcomes:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the important roots of knowledge system.
- To make the students understand the traditional knowledge and analyse it and apply it in their day to day life

Course Outcomes:

At the end of the Course, Student will be able to:

- Identify the concept of Traditional knowledge and its importance.
- Understand the need and importance of protecting traditional knowledge.
- Illustrate the various enactments related to the protection of traditional knowledge.
- Explain the importance of Traditional knowledge in Agriculture and Medicine.

Course Contents:

UNIT I:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge (Unani / Siddha/ Ayurveda), Indigenous Knowledge (IK)

UNIT II:

Protection of traditional knowledge: The need for protecting traditional knowledge, Significance of traditional knowledge Protection, value of traditional knowledge in global economy, Role of Government to harness traditional knowledge

UNIT III:

Traditional Knowledge in different Sectors: Traditional knowledge and engineering, Traditional medicine system, traditional knowledge in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of traditional knowledge

Suggested Learning Resources:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor.
3. Madhya Himalayi Sanskriti mein Gyan, Vigyan evam Paravigyan by Prof PC Pandey.

Suggested Online Link: Web Links:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

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Implementation of AICTE Model Curriculum 2019 for
Diploma in Engineering Courses in MANUU Polytechnics
(Hyderabad, Bangalore, Darbhanga, Kadapa, Cuttack)

Semester V

Curriculum for Diploma in Mechanical Engineering

S.No	Description	CourseTitle	Course code	Hours/Week			TotalContact Hrs/ Week	Credits
				L	T	P		
1	Program core Course	Theory of Machines & Mechanisms		2	1	0	3	3
2	Program core course	Industrial Engineering & Management		3	0	0	3	3
3	Program Elective Course	Any one Programme Elective-3		3	0	0	3	3
4	Program Elective course	Any one Programme Elective-4		3	0	0	3	3
5	OpenElective	Any one Open Elective-1		3	0	0	3	3
6	Program core Course	CAD/CAM Lab		0	0	2	2	1
7	Program core Course	Manufacturing Engineering Lab-II		0	0	2	2	1
8	Summer Internship-II (6 weeks) after IVth Sem	Summer Internship-II		0	0	0	0	3
9	Project	Major Project		0	0	2	2	
				14	1	6	21	**20**

Program Elective 3:

1. Power Plant
2. Refrigeration & Air Conditioning
3. Material Handling Systems

Program Elective 4:

1. Hybrid Vehicle
2. Industrial Robotics & Automation
3. Mechatronics

Open Elective 1:

1. Energy Efficiency & Audit
2. Product Design
3. Operations Research

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

Course Objectives:

- To know the functions and applications of Jigs and Fixtures.
- To understand the different moulding and fabrication methods 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 get familiarized with working principles of non-traditional machines, SPM, automated machines and understand the maintenance procedures of machine tools.

Course outcomes:

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

CO1: Understand the functions of Jigs and fixtures and their constructional details.
CO2: Identify the different fabrication methods viz., sheet forming, blow moulding, laminating and reinforcing of plastics.
CO3: Know different non-traditional machining processes, their principles and applications.
CO4: Understand the need of automation, SPMs and the maintenance procedures of machine tools.

Course Content:

UNIT-I: Jigs & Fixtures: Definition of Jig and Fixture; Types of jigs: Leaf jig, Box and Handle jig, Template jig, Plate jig, Indexing jig, Universal jig (constructional details); General consideration in the design of drill jigs; Drill bush; Types of fixtures: Vice fixtures, Milling fixtures, Boring fixtures, Grinding fixtures (constructional details); 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: Jig Boring: Introduction; Jig boring on vertical milling machine; Types of jig boring machines: Open front machine, Cross rail type machine - constructional details & their working;

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

Unit-III: Modern Machining Processes: Introduction - comparison with traditional machining; Ultrasonic Machining: principle, Description of equipment, applications; Electric Discharge Machining: Principle, Description of equipment, Dielectric fluid, tools (electrodes), Process parameters, Output characteristics, applications; Wire cut EDM: Principle, Description of equipment, applications; Abrasive Jet Machining: principle, description of equipment, application; Laser Beam Machining: principle, description of equipment, application;

Unit-IV: Machine Tool Automation: Introduction and Need; (A) Single spindle automats, transfer lines. (B) Elements of control system, Limit switches, Proximity switches, Block diagram for feedback and servo control system, Introduction to PLC, Block diagram of PLC.
Special Purpose Machines (SPM): Concept, General elements of SPM, Productivity improvement by SPM

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

Reference Books:

1. Production Technology - HMT, Banglore, Tata Mc-Graw Hill.
2. Non-conventional Machining - P. K. Mistra, NarvasaPublishining House.
3. Manufacturing Processes - Begman& Amsted, John Willey and Sons.
4. Advanced manufacturing technology - David L. Goetsch.
5. Exploring Advanced Manufacturing Technologies-Stephen F. Krar& Arthur Gil, Industrial Press

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Course Code	:	
Course Title	:	Theory Of Machines & Mechanisms.
Number of Credits	:	3 (L: 2, T: 1 P: 0)
Prerequisites	:	Engineering Mechanics (DPCE101EST)
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 understand the basics about air conditioning systemTo Know different types of governorss.

Course outcomes

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

CO1: Know different machine elements and mechanisms.
CO2: Select Suitable Brakes, Dynamometers Clutches & Bearings for a particular application.
CO3: Select Suitable Drives and Mechanisms for a particular application.
CO4: Understand different types of cams and their motions.

Course Content:

UNIT-I: Introduction: Rigid and Resistant Bodies, Definition of Link, Element, Kinematic Pair and their types. Degree of Freedom. Grubler's Criterion. Kinematic chain, Mechanism, Inversion of mechanism. Four bar chain, Single slider crank chain and it's inversions, Double slider crank chain. Straight-line mechanism, Pantograph.

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 (graphical method).

UNIT-II: Brakes, Dynamometers, Clutches & Bearings: Function of brakes and dynamometers; Types of brakes and Dynamometers; Comparison between brakes and dynamometers; Construction and working of shoe brake, Band Brake, Internal expanding shoe brake and Disc Brake; Concept of Self Locking & Self energizing brakes; Construction and working of Rope Brake Dynamometer, Hydraulic Dynamometer; Clutches- Uniform pressure and Uniform Wear theories; Function of Clutch and its application; Construction and working of Single plate clutch, Multi plate clutch, Centrifugal Clutch. (Simple problems on single and Multiplate clutch); Bearings – Simple Pivot, Collar Bearing. Torque & power lost in friction (no derivation). Simple problems.

UNIT-III: Power Transmission: Types of Drives – Belt, Chain, Rope, Gear drives & their comparison; Belt Drives - flat belt, V– belt & its applications; Material for flat and V-belt; Angle of lap, Belt length. Slip; Determination of Velocity Ratio, Ratio of tight side and slack side tension; Centrifugal tension and Initial tension; Condition for maximum power transmission (Simple numericals); Chain Drives – Advantages & Disadvantages; Gear Drives – Spur gear terminology; Law of gearing, Types of gears and gear trains; compound, reverted and simple epicyclic gear train; simple problems on compound gear train. Rope Drives – applications, advantages & limitations.

UNIT-IV:

Flywheel and Governors: Flywheel - Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C. Engine (no numericals); Coefficient 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 and applications & Terminology of Governors (no numericals); Comparison between Flywheel and Governor.

Balancing: Concept of balancing; Balancing of single rotating mass; Graphical method for balancing of several masses revolving in same plane;

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 – J B K Das, Sapna Publications.
5. Theory of machines – Jagdishlal, Bombay Metro – Politan book Ltd.

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Course Code	:	
Course Title	:	INDUSTRIAL ENGINEERING & MANAGEMENT
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	PC

Course Objectives:

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

Course outcomes:

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

CO1: Explain the different types of layout and plant maintenance with safety
CO2: List and explain the need of method study and work measurements
CO3: Explain the production planning and quality control, and its functions
CO4: Understand the basic principles, approaches and functions of management and identify concepts to specific situations

Course Content:

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

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

UNIT-II: Work Study: Productivity; Standard of living; Method of improving productivity; Objectives;
Need of good working conditions.

Method Study: Definition; Objectives; Selection of a job for method study; Basic procedure for conduct
of Method study; Tools used; Operation process chart; Flow process chart; String diagram and flow diagram.

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

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

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

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

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

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

Reference Books:

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

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Course Code	:	
Course Title	:	CAD/CAM LAB
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Computer Aided Machine Drawing (MEPC104)
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 programmes for various jobs.
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Course outcomes:

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

CO1: Explain the 3D commands and features of a CAD software
CO2: Create 3D solid model and find the mass properties of simple's solids
CO3: Demonstrate the working of CNC turning and milling machine
CO4: Develop the part program using simulation software for Lathe and Milling

Course Content:

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) Gib and Cotter joint; 4) Connecting Rod:

Note: Print the orthographic view and sectional view from the above assembled 3D drawing.

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 subprogram - 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. TamtaDhanpat Rai & Sons, Delhi, 1992.
3. Inside AutoCAD - 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.
5. Engineering AutoCAD, A.P. Gautam & Pradeep Jain, Khanna Book Publishing Co., Delhi.

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Course Code	:	
Course Title	:	MANUFACTURING ENGINEERING LAB-II
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	Manufacturing Engineering (MEPC205)
Course Category	:	PC

Course Objectives:

- To know the working of Drilling machine, shaper, slotter, planer, milling and grinding machines and be in a position to operate the same.
- To make use of various measuring instruments for taking dimensions.
- To Practice different operations on drilling shaper, slotter, planer, milling and grinding
- machines.

Course outcomes:

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

CO1: Dismantle and assemble the components on drilling, shaping, milling and grinding machines.

CO2: Perform operations on drilling, shaping, milling and grinding machines.

CO3: Produce articles of industrial application such as Spur gear, square headed bolt, V-block

C04: Make use of various measuring instruments for taking dimensions.

Course Content:

Perform any ten exercises from the following:

S.N	Topics for practice
I	Drilling Exercise (Three different sized holes for different materials maintaining uniform distance between them)
II	Milling-square-hexagon from round bars with indexing and without indexing.
III	Generation of spur gear teeth on a round bar.
IV	Simple planning exercise cutting 'T' slots (one model)
V	Shaping a Hexagon on a round bar, key ways, grooves splines.
VI	Shaping step block cut dovetail to angles 60, 90, 120 degrees.
VII	Cylindrical grinding of external surface and internal surface using universal grinding machines.
VIII	Grinding Cutting tools to the required angles.
IX	Grinding of milling cutters etc, on a tool and cutter grinder.
X	Grinding flat surface on a surface grinder using magnetic chuck and clamping
XI	Dismantling some of the components of drilling machine and service, assemble the same.
XII	Dismantling some of the components of shaper head and then assemble the same.
XIII	Dismantling some of the components of Milling machines and service, assemble the same.
XIV	Servicing of universal grinding machine.

Reference Books:

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

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Course Code	:	MEPE###
Course Title	:	POWER PLANT ENGINEERING
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	Thermal Engineering - I (MEPC202)
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 outcomes

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

CO1: Familiarized with the present and future power scenario of India.
CO2: Enlist various load terminologies in power plants
CO3: Working and classifications in hydro power plant
CO4: Working principles of Diesel, Gas and Nuclear power plants

Course Content:

UNIT-I: 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.
Wind power plant: -Horizontal axis wind turbine (HAWT) Vertical axis wind turbine Wind energy conversion system (WECS) advantages and disadvantages-limitations of Wind power plant.,
Economics of power plant: Terminology used in power plant: Peak load, Base load, Load factor, Load curve.

Unit-II: Hydro power plant: Introduction to Hydroelectric power plant, Hydrograph, flow duration curve; Selection of sites for hydroelectric power plant; General layout of Hydroelectric power plant and its working, Advantages and disadvantages of hydroelectric power plant.

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-III: 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).

Unit-IV: Environmental impact of Power plant: Social and Economic issues of power plant; Green house effect; Acid precipitation-Acid rain, Thermal pollution from power plants

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;

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.

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Course Code	:	
Course Title	:	REFRIGERATION AND AIR-CONDITIONING
Number of Credits	:	3 (L: 3, T: 0, 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 outcomes

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

CO1: Define refrigeration and types of Refrigeration cycles
CO2: Explain Vapour Compression and Vapour Absorption System working principles
CO3: Identify the components required for refrigeration system.
CO4: Explain the working principles of Air-conditioning.

Course Content:

UNIT 1

Introduction to Refrigeration: Definition of Refrigeration; Refrigerating effect, unit of refrigeration, COP; Types of Refrigeration-Ice, dry ice, Throttling, Liquid nitrogen refrigeration; Carnot refrigeration Cycle; Air refrigeration- Bell - Coleman cycle, PV& TS diagram; Simple problems.

Vapour Compression Refrigeration systems: Basic Components, Flow diagram of working of Vapour compression cycle; Representation of the Vapour compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required, Effects of super heating and under cooling, its advantages and disadvantages; Simple problems.

UNIT – 2

Vapour Absorption Refrigeration system: Simple Vapour absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapour absorption and vapour compression system.

Refrigeration equipment: Compressor - types of compressors; 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.

UNIT – 3

Refrigerants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Designation of refrigerants.

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

UNIT - 4

Air conditioning: Introduction to Air conditioning; Factors affecting Air conditioning; Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and

dehumidifying; Adiabatic saturation process; Equipment used in air conditioning cycle; Different types of air conditioning system.

Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; 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.ZakriaBaig, Premier/ Radiant Publishing House.
6. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

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

Course Objectives:

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

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

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

Course Content:

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

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

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

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

Reference Books:

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

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Course Code	:	
Course Title	:	INDUSTRIAL ROBOTICS & AUTOMATION
Number of Credits	:	3 (L: 3, T: 0, 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 applications in robots and programming of robots.
- To select the robots according to its usage.
- To discuss about the various applications of robots, justification and implementation of robot.

Course outcomes:

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

CO1: Explain the robot anatomy, classification, characteristics of robot, advantages and disadvantages.
CO2: Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
CO3: Explain about various types of sensors and concepts on robot vision system.
CO4: Explain the concepts of robot programming languages and various applications of robots.

Course Content:

UNIT-I: Fundamentals of Robotics: Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Degrees of freedom, work envelope and work volume, Classification of robots; Cartesian, Cylindrical, Spherical, SCARA, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; comparison; Advantages and disadvantages of robots.

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

Unit-III: Sensors: Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers); Range sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing.
Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Vidicon camera (Working principle & construction); Applications of Robot vision system: Inspection and Identification

Unit-IV: Robot kinematics and Robot Programming: Basic Transformations, translation and rotation matrices, Homogeneous transformation matrix, simple numericals; DefinitionofForward Kinematics; Inverse Kinematics; Forward and Inverse Kinematics of R-R planar manipulator. Definition of Path and Trajectory Planning; Teach Pendant Programming; Lead through programming; Robot programming Languages.

Automation: Definition, Basic elements of automated system, levels of automation, advanced automation functions. Industrial Applications:Application of robots in material handling; welding; painting and assembly operations.

Reference Books:

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

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

Course Learning Objectives:

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

Course outcomes:

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

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

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

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

CO4: Understand the characteristics of different types of decisions.

Course Content:

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

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

UNIT-II: Transportation Problem: Formulation; Finding an Initial feasible solution, Optimal solution by stepping stone and MODI methods; Degeneracy; Unbalanced Transportation problems;

Assignment problem: Formulation; Optimal solution, Hungarian method of Assignment Problems. Travelling salesman problem.

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

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

Reference Books:

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

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

Course Objectives:

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

Course Outcomes:

After Completing this Course, Students will be able to

CO1: Undertake energy efficiency activities.
CO2: Use energy efficient pumps, compressors and blowers.
CO3: Use energy efficient Air Compressors and DG sets.
CO4: Use energy efficient Lighting Systems and Apply energy efficient electrical machines.

Course Contents:

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

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

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

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

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

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

References:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A

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

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

Course Learning Objectives:

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

Course outcomes:

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

CO1: Understand the basic concepts of product design and development process.
CO2: Illustrate the methods to define the customer needs
CO3: Understand the intuitive and advanced methods used to develop and evaluate a concept.
CO4: Apply modelling and embodiment principles in product design and development process.

Course Content:

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

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

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

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

Reference Books:

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

Implementation of AICTE Model Curriculum 2019 for
Diploma in Engineering Courses in MANUU Polytechnics
(Hyderabad, Bangalore, Darbhanga, Kadapa, Cuttack)

Semester VI

Curriculum for Diploma in Mechanical Engineering

Course Code	**Category**	**Course Title**	**Hours per week**			**Total contact hrs/week**	**Credits**
			L	**T**	**P**		
1	Program core course	Design of Machine Elements	2	1	0	3	3
2	Program core course	Production & Operations Management	3	0	0	3	3
3	Program core course	Entrepreneurship and Start-ups	2	1	0	3	3
4	Open Elective course–2 (OE2)	Open Elective course–2	3	0	0	3	3
5	Open Elective course–3 (OE3)	Open Elective course–3	3	0	0	3	3
6	Mandatory Course	Indian Constitution	0	0	3	3	0
7	Major Project		0	0	6	6	4^
8	Seminar		0	0	0	1	1
Total							**20**

Open Elective – 2:

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

Open Elective – 3:

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

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

Course Objectives:

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

Course outcomes:

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

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

CO2: Design Simple Machine parts and Bearings.

CO3: Design Shafts, Keys, Couplings and Spur Gear.

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

Course Content:

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

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

UNIT-III: Design of Shaft, Keys, Couplings and Spur Gears: Design of shaft for combined loading; Design of Sunk Keys; Design of Couplings – Muff Coupling, Protected type Flange Coupling;
Spur Gear: Design considerations; Lewis equation for static beam strength of spur gear teeth; Power transmission capacity of spur gears in bending.

UNIT-IV: Design of Fasteners and Springs: Stresses in Screwed fasteners; Bolts of Uniform Strength; Design of Bolted Joints subjected to eccentric loading;
Design of springs: Classification and Applications of Springs; Spring terminology; Materials and

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

Reference Books:

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

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

Course Learning 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 behaviour and strategy into a consolidated production and operation related decision.
- 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 outcomes:

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

CO1: Define operations management and explain its relationship to productivity. And also understand tools and techniques.

CO2: Describe the importance of forecasting and explain the effective application of the different forecasting approaches and methods.

CO3: Explain layout strategy and how operations managers determine facility arrangements and size.

CO4: Describe how operations managers achieve a reasonable work environment and set expectations related to employee productivity.

Course Content:

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

UNIT-II: 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: 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: 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.
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 Publishing House, 2014.
2. Production and Operations Management – Shailendra Kale, McGraw Hill Educations (India) Private Limited,2013.
3. Production and Operations Management – R. Paneerselvam, PHI Learning Private Limited, 2013.
4. Operations Management – Joseph Monk, TMH Publishers, New Delhi, 2004.
5. Modern Production /Operations Management – Buffa Elwood S, John Wiley Publishers, Singapore, 2002.

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

Course Learning Objectives:

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

Course outcomes:

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

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

CO2: Select a specific material for the given application.

CO3: Select a 3-D printing process for an application.

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

Course Content:

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

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

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

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

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

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

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

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

Reference Books:

1. Lan Gibson, David W.Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Proto typing to Direct Digital Manufacturing”,Springer,2010.
2. KhannaEditorial,“3D Printing and Design”, Khanna Publishing House, Delhi. CK Chua, KahFai Leong, “3D Printing and Rapid Prototyping- Principles and Applications” ,World Scientific, 2017.

3. J.D. Majumdar and I.Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.

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

Course Objectives:

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

Course Outcomes:

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

CO1: Understand the basics of Mechatronics and its importance

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

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

CO4: Understand the elements, functioning of hydraulic and pneumatic systems

Course Content:

Unit-I: Introduction

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

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

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

Unit-II: Elements in Mechatronics

Sensors and transducers: Definition and classification of transducers, Schematic diagram, working principle and applications of Proximity Sensor and Hall Effect sensor; Definition of micro-sensors.

Signal processing devices: Circuit, working principle and applications of Electronic filters (LPF,HPF,BPF,BRF) and Operational Amplifier; Data conversion devices: Overview of ADCs and DACs; Circuit, working and applications of 3-bitFlashADC and Binary-weighted DAC.

Microprocessors: Generic architecture, features and applications.

PID Controllers: Block diagram, operation and applications.

Unit-III: Power transmission elements and Drives

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

Stepper Motors, Servo Drives, Solenoids.

Unit-IV: Hydraulic and Pneumatic Systems

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

Reference Books:

1. Mechatronics – Bolton. W, Pearson Education, 2014
2. Mechatronics, HMT Ltd, Tata McGraw Hill, New Delhi, 1998,
3. Analysis and design of Dynamic Systems Cochin ,Eraand Cadwallender AddisonWesley, 1997
4. Mechatronics Engineering -Tomkinson, D.AndHorne, J.Longman, McGraw Hill,1996
5. Fundamentals of mechatronics-M.Jouaneh Cengage Learning,ISBN–978-1111569020
6. Mechatronics–An Integrated Approach-Clarence W.deSilva CRC Press

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

Course Objectives:
The aim of this course is to:

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

Course Outcomes:
By the end of this course, the students are expected to learn

CO1: Understand the importance of projects and its phases.
CO2: Analyze the projects from various perspectives and evaluate them on discount method.
CO3: Develop network diagrams for planning and execution of a given project.
CO4: Apply crashing procedures for time and cost optimization

Course contents:
Unit-I: Concept of a Project and Capital Budgeting
Classification of projects, Importance of project management, Project life cycle, Establishing project priorities (scope-cost-time) Planning, Analysis, Selection, Financing, Implementation, Generation and screening of project ideas, Market and Demand analysis, Demand forecasting techniques.

Unit-II: Financial Estimates and Projections
Cost of projects, means of financing, estimates of sales and production, cost of production, working capital requirement and its financing, Break even analysis

Unit-III: Basic Techniques in Capital Budgeting
Non discounting and discounting methods, Payback period, Accounting rate of return, Net present value, Benefit cost ratio, Internal rate of return, Project risk, Social cost benefit analysis and economic rate of return.

Unit-IV: Project Administration
Expenditure planning, Project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off.
Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms, Post project evaluation, Introduction to various Project management softwares.

References:

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

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

Course Objectives:

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

- To Identify demand supply gaps in present scenario.
- To understand conservations approaches to an industry.
- To draw the energy flow diagram of an industry.
- To identify energy wastage and suggest alternative methods.
- To understand the concepts energy audit.

Course Outcomes:

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

CO1: Identify demand supply gaps in the present scenario.
CO2: Understand the conservation approaches for an industry.
CO3: Draw the energy flow diagram of and industry and identify waste stream.
CO4: Identify energy wastage and evaluate the concepts of energy audit.

Course Contents:

Unit-I: Introduction

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

Unit-II: Energy Conservation Approaches and Option

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

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

Unit-III: Performance improvement of existing power plant

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

Unit-IV: Energy Audit

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

References:

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

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

Course Objectives:

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

Course outcomes:

After Completing this Course, Students will be able to

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

Course Content:

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

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

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

Unit-IV: Bio Energyand Other Renewable Energy Sources:
Biomass direct combustion, Biomass gasifiers, Biogas plants, Bio diesel, Biomass applicationsTidal energy; Wave Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

References :

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

7. Energy and The Environment, RA Ristinen and J JKraushaar, Second Edition, John Willey & Sons, New York, 2006. 8. Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006.

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

Course Objectives:

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

Course outcomes:

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

CO1: Explain the robot anatomy, classification, characteristics of robot, advantages and Disadvantages.
CO2: Explain the various robotic actuators on hydraulic, pneumatic and electrical drives.
CO3: Explain about various types of sensors and concepts on robot vision system.
CO4: Explain the concepts of robot programming languages and various applications of robots.

Course Content:

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

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

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

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

Unit-IV: Robot kinematics and Robot Programming: Definition of Forward Kinematics; Inverse Kinematics; Forward and Inverse Kinematics of R-R planar manipulator.
Definition of Path and Trajectory Planning; Teach Pendant Programming; Lead through programming; Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands.

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

Reference Books:

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

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Entrepreneurship and start-ups

Course Learning Objectives:

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

Course contents

Unit -I

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

Unit -II

Business Ideas and their implementation: Discovering ideas and visualizing the business, Activity map, Business Plan.

Unit -III

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

Unit -IV

Management, and Financing & Protecting Ideas

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

Text And Reference Books:

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

Course Outcome:

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

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

Course Title: **Indian Constitution** Course Code:

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

Course Content

Unit 1 – The Constitution - Introduction

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

Unit 2 – Union Government

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

Unit 3 – State Government

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

Unit 4 – Local Administration

- District Administration
- Municipal Corporation
- Zila Panchayat

Unit 5 – Election Commission

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

Suggested Learning Resources:

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

Suggested Software/Learning Websites:

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

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

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

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

MINOR PROJECT

Course Objectives:

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

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

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

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

Schedule:

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

Guidelines for the Award of marks:

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

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

MAJOR PROJECT

Course Objectives:

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

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

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

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

Schedule:

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

Guidelines for the Award of marks:

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

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