Materials Science and Metallurgical Engineering

School of Engineering and Technology (UIET)

Diploma in Metallurgy and Material Technology

Semester-wise Detailed Curriculum

Semester I

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1.	Basic Science	BS101	Mathematics-I	2	1	0	3	3
2.	Basic Science	BS103	Applied Physics-I	2	1	0	3	3
3.	Basic Science	BS105	Applied Chemistry	2	1	0	3	3
4.	Humanities & Social Science	HS101	Communication Skills in English	2	0	0	2	2
5.	Engineering Science	ES101	Engineering Graphics	0	0	3	3	1.5
6.	Engineering Science	ES103	Engineering Workshop Practice	0	0	3	3	1.5
7.	Basic Science	BS107	Applied Physics-I Lab	0	0	2	2	1
8.	Basic Science	BS109	Applied Chemistry Lab	0	0	2	2	1
9.	Humanities & Social Science	HS103	Sports and Yoga	0	0	2	2	1
10.	Humanities & Social Science	HS105	Communication Skills in English Lab	0	0	2	2	1
	Total Credits							**18**

Semester II

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1	Basic Science	BS102	Mathematics-II	3	1	0	4	4
2	Basic Science	BS104	Applied Physics-II	2	1	0	3	3
3	Engineering Science	ES102	Introduction to IT Systems	2	0	0	2	2
4	Engineering Science	ES104	Fundamentals of Electrical& Electronics Engineering	2	1	0	3	3
5	Engineering Science	ES106	Engineering Mechanics	2	1	0	3	3
6	Basic Science	BS106	Applied Physics-II Lab	0	0	2	2	1
7	Engineering Science	ES108	Introduction to IT SystemsLab	0	0	4	4	2
8	Engineering Science	ES110	Fundamentals of Electrical& Electronics Engineering Lab	0	0	2	2	1
9	Engineering Science	ES112	Engineering MechanicsLab	0	0	2	2	1
10	Audit	AU102	Environmental Science	2	0	0	2	0
Total Credits								**20**

Semester III

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Program core course	DM – 301	Basic Metallurgy	3	0	0	3	3
2	Program core course	DM – 301P	Basic Metallurgy Lab	0	0	2	2	1
3	Program core course	DM – 302	Testing of Materials	3	0	0	3	3
4	Program core course	DM – 302P	Testing of Materials Lab	0	0	2	2	1
5	Program core course	DM – 303	Physical Metallurgy	3	0	0	3	3
6	Program core course	DM – 303P	Physical Metallurgy Lab	0	0	2	2	1
7	Program core course	DM – 304	Metallurgical Thermodynamics	3	0	0	3	3
8	Program core course	DM – 305	Iron Making	3	0	0	3	3
9	Program core course	DM – 306	Heat Treatment of Metals	3	0	0	3	3
10	Program core course	DM – 306P	Heat Treatment of Metals Lab	0	0	2	2	1
11	Summer Intern- ship-I (4 weeks)after IInd Sem	SI – 301	Internship	0	0	0	0	2
Total				**18**	**0**	**8**	**26**	**24**

Semester – IV

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Program core course	DM – 401	Metal Working - I	3	0	0	3	3
2	Program core course	DM – 401P	Metal Working – I Lab	0	0	2	2	1
3	Program core course	DM – 402	Steel Making	3	0	0	3	3
4	Program core course	DM – 403	Extractive Metallurgy (Non – Ferrous)	3	0	0	3	3
5	Program core course	DM – 404	Metallurgical Analysis	3	0	0	3	3
6	Program core course	DM – 404P	Metallurgical Analysis Lab	0	0	2	2	1
7	Program core course	DM – 405	Elements of Foundry Technology	3	0	0	3	3
8	Program core course	DM – 405P	Elements of Foundry Technology Lab	0	0	2	2	1
9	Program core course	DM – 406	Professional Practice – I	0	0	4	4	2
10	Seminar	SE – 401	Seminar	1	0	0	1	1
Total				**16**	**0**	**10**	**26**	**21**

Semester – V

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Program core course	DM – 501	Metal Working – II	3	0	0	3	3
2	Program core course	DM – 501P	Metal Working – II Lab	0	0	2	2	1
3	Program core course	DM – 502	Material Management and quality control	3	0	0	3	3
4	Program core course	DM – 503	Mineral Dressing	3	0	0	3	3
5	Program core course	DM – 503P	Mineral Dressing Lab	0	0	2	2	1
6	Program core course	DM – 504	Metallurgical Design	3	0	0	3	3
7	Program core course	DM – 505	Corrosion and Surface Engineering	3	0	0	3	3
8	Minor Project	PR – 506	Minor Project	0	0	4	4	2
9	Summer Intern- ship-II (6 weeks) after IVth Sem	SI – 507	Internship	0	0	0	0	3
Total				**15**	**0**	**8**	**23**	**22**

Semester – VI

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1	Program core course	DM – 601	Welding Technology	3	0	0	3	3
	Program core course	DM – 601P	Welding Technology Lab	0	0	2	2	1
2	Program core course	DM – 602	Applied Material Science	3	0	0	3	3
	Program core course	DM – 602P	Applied Material Science Lab	0	0	2	2	1
3	Program core course	DM – 603	Fuel Furnace and Refractories	3	0	0	3	3
4	Humanities and Social Science course	HS – 604	Entrepreneurship Development & Industrial Organization / Management	3	0	0	3	3
5	Program core course	DM – 605	Professional Practice II	0	0	4	4	2
6	Major Project	PR – 606	Major Project	0	0	8	8	4
Total				**12**	**0**	**16**	**28**	**20**

Detailed First Year Curriculum Contents
SEMESTER - I

Course Code	:	BS101
Course Title	:	Mathematics- I
Number of Credits	:	3 (L:2,T:1,P:0)
Prerequisites	;	NIL
Course Category	:	BS

Course Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of 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 $\lim_{x \to a} (1+x)^{\frac{1}{x}}$

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

UNIT - III: Algebra

Complex Numbers: Definition, real and imaginary parts of a Complex number, polar and Cartesian, representation of a complex number and its conversion from one form to other, conjugate of a complex number, modulus and amplitude of a complex number Addition, Subtraction, Multiplication and Division of a complex number. De-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 ^nP_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. Reena Garg, Engineering Mathematics, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. V. Sundaram, R. Balasubramanian, K.A. Lakshminarayanan, Engineering Mathematics, 6/e., Vi-

kas Publishing House.

5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

Course Outcomes:

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

(i) The students are expected to acquire necessary background in Trigonometry to appreciate the importance of the geometric study as well as for the calculation and the mathematical analysis.

(ii) The ability to find the effects of changing conditions on a system.

(iii) Complex numbers enter into studies of physical phenomena in ways that most people cannot imagine.

(iv) The partial fraction decomposition lies in the fact that it provides an algorithm for computing the antiderivative of a rational function.

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Course Code	:	BS103
Course Title	:	Applied Physics –I
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

Course Objectives:

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

Teaching Approach:

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

Course Content:

Unit 1: Physical world, Units and Measurements

Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units),

Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis.

Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.

Unit 2: Force and Motion

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

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications.

Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

Unit 3: Work, Power and Energy

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

Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples).

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

Unit 4: Rotational Motion

Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications.

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

Unit 5: Properties of Matter

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

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.
Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems.

Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem (only formula and numericals) and its applications.

Unit 6: Heat and Thermometry

Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses.

Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering 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.
- State the principle of conservation of energy. Identify various forms of energy, and energy transformations.
- Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
- Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces.
- Describe the viscosity of liquids, coefficient of viscosity and the various factors affecting its value. Determine viscosity of an unknown fluid using Stokes' Law and the terminal velocity.
- Define stress and strain. State Hooke's law and elastic limits, stress–strain diagram, determine; (a) the modulus of elasticity, (b) the yield strength (c) the tensile strength, and (d) estimate the percent elongation.
- Illustrate the terms; heat and temperature, measure temperature in various processes on different scales (Celsius, Fahrenheit, and Kelvin etc.)
- Distinguish between conduction, convection and radiation; identify different methods for reducing heat losses and mode of heat transfer between bodies at different temperatures.
- State specific heats and measure the specific heat capacity of solids and liquids.

References:

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

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Course Code	:	BS105
Course Title	:	Applied Chemistry
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Chemistry
Course Category	:	BS

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.

Course Content:

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

  Rutherford model of atom, Bohr's theory (expression of energy and radius to be omitted), and hydrogen spectrum explanation based on Bohr's model of atom, Heisenberg uncertainty principle, 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 (H_2, F_2, HF hybridization in $BeCl_2$, BF_3, CH_4, NH_3, H_2O), coordination bond in NH_4^+, and anomalous properties of NH_3, H_2O due to hydrogen bonding, and metallic bonding.

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

- **Unit 2: Water**

  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), and quantitative measurement of water hardness by ETDA method, total dissolved solids (TDS) alkalinity estimation.

  i). Water softening techniques – soda lime process, zeolite process and ion exchange process.

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

  Water for human consumption for drinking and cooking purposes from any water sources and enlist Indian standard specification of drinking water (collect data and understand standards).

- **Unit 3: Engineering Materials**

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

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

General chemical composition, composition based applications (elementary idea only details omitted):

Port land cement and hardening, Glasses Refractory and Composite materials.

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

- **Unit 4: 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.

Proximate analysis of coal solid fuel

petrol and diesel - fuel rating (octane and cetane numbers),

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

Lubrication – function and characteristic properties of good lubricant, classification with examples, lubrication mechanism – hydrodynamic and boundary lubrication, 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 5: 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 Sessional work:

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

  Assignments: Writing electronic configuration of elements up to atomic number 30 (Z= 30). Numerical on molarity, ppm, mass percentage, volume percentage and mole fraction of given solution.

  Seminar: 1. Quantum numbers,

  2. Discuss the metallic properties such as malleability, ductility, hardness, high melting point, conductance of heat and electricity, magnetic properties of metals.

  Projects: Model of molecules $BeCl_2$, BF_3, CH_4, NH_3, H_2O.

- **Unit 2: Water**

  Assignments: Simple problems on hardness calculation.

  Seminar: 1. Quality and quantity requirement of water in house and industry.

  2. Quality of control measures of effluents (BOD & COD).

  Projects: Collect water samples from different water sources and measure of hardness of water.

- **Unit 3: Engineering Materials**

  Assignments: Preparation of table showing different ores of iron, copper and aluminium metals along with their chemical compositions and classify in to oxide sulphide halide ores.

  Seminar: Discuss the chemical reactions taking place in blast furnace in extraction of Fe, Cu and Al metals.

  Projects: Make table showing place of availability of different ores in India and show places on India map.

- **Unit 4: Chemistry of Fuels and Lubricants**

  Assignments: Calculation of HCV and LCV of fuel using fuel composition in Dulong's formula.

  Seminar: Chemical structure of fuel components influence on fuel rating.

  Projects: Mapping of energy recourses in India. Collection of data of various lubricants available in the market.

- **Unit 5: Electro Chemistry**

  Assignments: Simple problems on Faradays laws of electrolysis.

  Seminar: 1. Corrosion rate and units.

  2. Corrosion preventions.

  Projects: Mapping of area in India prone to corrosion. Collection of data of various electrochemical cells batteries used in equipment and devices and available in market. Visit to sites such as Railway station to watch corrosion area in railways and research establishment in and around the institution.

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 met-

al, 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.

References/Suggested Learning Resources:

(a) Books :

1) Text Book of Chemistry for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi, 2017-18.
2) Agarwal, & Shikha, Engineering Chemistry, Cambridge University Press; New Delhi, 2015.
3) C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
4) Dara, S. S. & Dr.S.S.Umare, Engineering Chemistry, S.Chand. Publication, New Delhi, New Delhi, 2015.
5) Jain & Jain, Engineering Chemistry, Dhanpat Rai and Sons; New Delhi, 2015.
6) Dr. Vairam, S., Engineering Chemistry, Wiley India Pvt.Ltd., New Delhi, 2013.
7) Dr. G. H. Hugar & Prof A. N. Pathak, Applied Chemistry Laboratory Practices, Vol. I and Vol. II, NITTTR, Chandigarh, Publications, 2013-14.
8) Agnihotri, Rajesh, Chemistry for Engineers, Wiley India Pvt.Ltd., 2014.

(b) Open source software and website address:

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

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

Course Objectives:

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

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 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.

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

Course outcomes:

At the end of this course, the participants will:

- 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.

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

Course Objectives:

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

Course Content

Unit – I Basic elements of Drawing

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

Convention of lines and their applications.

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

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

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)

Unit – III Isometric Projections

Introduction to isometric projections.

Isometric scale and Natural scale.

Isometric view and isometric projection.

Illustrative problems related to objects containing lines, circles and arcs shape only.

Conversion of orthographic views into isometric view/projection.

Unit – IV Free Hand Sketches of engineering elements

Free hand sketches of machine elements: Thread profiles, nuts, bolts, studs, set screws, 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 – V Computer aided drafting interface

Computer Aided Drafting: concept.

Hardware and various CAD software available.

System requirements and Understanding the interface.

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

Unit – VI Computer aided drafting

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

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

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

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

Dim scale variable.

Editing dimensions.

Text: Single line Text, Multiline text.

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

S. No.	Practical Exercises	Unit No.	Approx. Hrs
1	Draw horizontal, Vertical, 30 degree, 45 degree, 60 and 75 degrees lines, different types of lines, dimensioning styles using Tee and Set squares/ drafter. (do this exercise in sketch book)	I	02
2	Write alphabets and numerical (Vertical only) (do this exercise in sketch book)	I	02
3	Draw regular geometric constructions and redraw the given figure (do this exercise in sketch book) Part I	II	02
4	Draw regular geometric construction and redraw the given figure (do this exercise in sketch book) Part II	II	02
5	Draw a problem on orthographic projections using first angle method of projection having plain surfaces and slanting. Part I	III	02
6	Draw another problem on orthographic projections using first angle method of projection having slanting surfaces with slots. Part II	III	02
7	Draw two problems on orthographic projections using first angle method of projection having cylindrical surfaces, ribs. Part I	III	02
8	Draw two problems on Isometric view of simple objects having plain and slanting surface by using natural scale. Part I	IV	02
9	Draw some problems on Isometric projection of simple objects having cylindrical surface by using isometric scale. Part I	IV	02
10	Draw free hand sketches/ conventional representation of machine elements in sketch book such as thread profiles, nuts, bolts, studs, set screws, washers, Locking arrangements. Part I	V	02
11	Problem based Learning: Given the orthographic views of at least three objects with few missing lines, the student will try to imagine the corresponding objects, complete the views and draw these views in sketch book. Part I	III, II, V	02
12	Draw basic 2D entities like: Rectangle, Rhombus, Polygon using AutoCAD (Print out should be a part of progressive assessment). Part I	V	02
13	Draw basic 2D entities like: Circles, Arcs, circular using AutoCAD (Printout should be a part of progressive assessment). Part II	V	02
14	Draw basic 2D entities like: Circular and rectangular array using AutoCAD (Printout should be a part of progressive assessment). Part III	V	02

15	Draw blocks of 2D entities comprises of Rectangle, Rhombus, Polygon, Circles, Arcs, circular and rectangular array, blocks using AutoCAD (Print out should be a part of progressive assessment). Part IV	V	02
16	Draw basic branch specific components in 2D using AutoCAD (Print out should be a part of term work). Part I	VI	02
17	Draw complex branch specific components in 2D using AutoCAD (Print should be a part of progressive assessment). Part I	VI	02
	Total		**34**

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 HousePvt. Ltd, Noida, 2011; ISBN: 978-8125953005.
9. Autodesk. *AutoCAD User Guide.* Autodesk Press, USA, 2015.
10. Sham, Tickoo. *AutoCAD 2016 for Engineers and Designers.* Dreamtech Press; Galgotia Publication, New Delhi, 2015; ISBN 978-9351199113.

Software/Learning Websites

1. https://www.youtube.com/watch?v=TJ4jGyD-WCw
2. https://www.youtube.com/watch?v=dmt6_n7Sgcg
3. https://www.youtube.com/watch?v=_MOScnLXL0M
4. https://www.youtube.com/watch?v=3WXPanCq9LI
5. https://www.youtube.com/watch?v=fvjk7PlxAuo
6. http://www.me.umn.edu/coursesme2011/handouts/engg%20graphics.pdf
7. https://www.machinedesignonline.com

Course Outcomes

Following outcomes will be achieved:

1) Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing

2) Draw views of given object and components 3) Sketch orthographic projections into isometric projections and vice versa.

3) Apply computer aided drafting tools to create 2D engineering drawings

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

Course Objectives:

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

Course Content:

S.No.	Details Of Practical Content
I	**Carpentry:** i) Demonstration of different wood working tools / machines. ii) Demonstration of different wood working processes, like plaining, marking, chiseling, grooving, turning of wood etc. iii) One simple job involving any one joint like mortise and tenon dovetail, bridle, half lap etc.
II	**Fitting:** i) Demonstration of different fitting tools and drilling machines and power tools ii) Demonstration of different operations like chipping, filing, drilling, tapping, sawing, cutting etc. iii) One simple fitting job involving practice of chipping, filing, drilling, tapping, cutting etc
III	**Welding:** i) Demonstration of different welding tools / machines. ii) Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding. iii) One simple job involving butt and lap joint
IV	**Sheet Metal Working:** i) Demonstration of different sheet metal tools / machines. ii) Demonstration of different sheet metal operations like sheet cutting, bending, edging, end curling, lancing, soldering, brazing, and riveting. iii) One simple job involving sheet metal operations and soldering and riveting.
V	**Electrical House Wiring:** Practice on simple lamp circuits (i) one lamp controlled by one switch by surface conduit wiring, (ii) Lamp circuits- connection of lamp and socket by separate switches, (iii) Connection of Fluorescent lamp/tube light, (iv) simple lamp circuits-install bedroom lighting. And (v) Simple lamp circuits- install stair case wiring.
VI	**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

References:

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

Course outcomes

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

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

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

Course Objectives

Study of Applied Physics aims to give an understanding of physical world by observations and predictions. Concrete use of physical principles and analysis in various fields of engineering and technology is very 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.

List of Practical's/Activities (To perform minimum 10 practical's).

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook's Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the viscosity of a given liquid (Glycerin) by Stoke's law.
10. To find the coefficient of linear expansion of the material of a rod.
11. To determine atmospheric pressure at a place using Fortin's barometer.
12. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

Learning Outcome:

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

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

SUGGESTED STUDENT ACTIVITES & STRATEGIES

Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course

a. Make survey of different physical products and compare the following points
    - Measurements of dimensions
    - Properties
    - Applications
b. Library survey regarding engineering materials/products used in different industries
c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences.

References:

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

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

Course Objectives:

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

LIST OF PRACTICALS:

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. Determination of flash and fire point of lubricating oil using Able's flash point apparatus.
13. To verify the first law of electrolysis of copper sulfate using copper electrode.
14. Construction and measurement of emf of elector chemical cell (Daniel cell).
15. To study the effect of dissimilar metal combination.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences
- Encouraging students to visit to sites such as Railway station and research establishment around the institution.

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.
- To construct different electrochemical cells used in developing batteries.
- To understand and appreciate methods of corrosion abetments.

Reference Books:

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

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

Course Objectives:

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

Course Content:

- **Introduction to Physical Education**
  - Meaning & definition of Physical Education
  - Aims & Objectives of Physical Education
  - Changing trends in Physical Education
- **Olympic Movement**
  - Ancient & Modern Olympics (Summer & Winter)
  - Olympic Symbols, Ideals, Objectives & Values
  - Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)
- **Physical Fitness, Wellness & Lifestyle**
  - Meaning & Importance of Physical Fitness & Wellness
  - Components of Physical fitness
  - Components of Health related fitness
  - Components of wellness
  - Preventing Health Threats through Lifestyle Change
  - Concept of Positive Lifestyle
- **Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**
  - Define Anatomy, Physiology & Its Importance
  - Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)
- **Kinesiology, Biomechanics & Sports**
  - Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
  - Newton's Law of Motion & its application in sports.
  - Friction and its effects in Sports.
- **Postures**
  - Meaning and Concept of Postures.
  - Causes of Bad Posture.
  - Advantages & disadvantages of weight training.
  - Concept & advantages of Correct Posture.
  - Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
  - Corrective Measures for Postural Deformities

- **Yoga**
  - Meaning & Importance of Yoga
  - Elements of Yoga
  - Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
  - Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Sha-shankasana)
  - Relaxation Techniques for improving concentration - Yog-nidra
- **Yoga & Lifestyle**
  - Asanas as preventive measures.
  - Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
  - Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
  - Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
  - Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.
  - Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.
- **Training and Planning in Sports**
  - Meaning of Training
  - Warming up and limbering down
  - Skill, Technique & Style
  - Meaning and Objectives of Planning.
  - Tournament – Knock-Out, League/Round Robin & Combination.
- **Psychology & Sports**
  - Definition & Importance of Psychology in Physical Edu. & Sports
  - Define & Differentiate Between Growth & Development
  - Adolescent Problems & Their Management
  - Emotion: Concept, Type & Controlling of emotions
  - Meaning, Concept & Types of Aggressions in Sports.
  - Psychological benefits of exercise.
  - Anxiety & Fear and its effects on Sports Performance.
  - Motivation, its type & techniques.
  - Understanding Stress & Coping Strategies.

- **Doping**
  - o Meaning and Concept of Doping
  - o Prohibited Substances & Methods
  - o Side Effects of Prohibited Substances
- **Sports Medicine**
  - o First Aid – Definition, Aims & Objectives.
  - o Sports injuries: Classification, Causes & Prevention.
  - o Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries
- **Sports / Games**

  Following sub topics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.
  - o History of the Game/Sport.
  - o Latest General Rules of the Game/Sport.
  - o Specifications of Play Fields and Related Sports Equipment.
  - o Important Tournaments and Venues.
  - o Sports Personalities.
  - o Proper Sports Gear and its Importance.

References:

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

Course Outcomes:

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

(i) Practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.

(ii) Learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.

(iii) Learn breathing exercises and healthy fitness activities

(iv) Understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.

(v) Perform yoga movements in various combination and forms.

(vi) Assess current personal fitness levels.

(vii) Identify opportunities for participation in yoga and sports activities.

(viii) Develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.

(ix) Improve personal fitness through participation in sports and yogic activities.

(x) Develop understanding of psychological problems associated with the age and lifestyle.

(xi) Demonstrate an understanding of sound nutritional practices as related to health and physical performance.

(xii) Assess yoga activities in terms of fitness value.

(xiii) Identify and apply injury prevention principles related to yoga and physical fitness activities.

(xiv) Understand and correctly apply biomechanical and physiological principles elated to exercise and training.

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

Course Objectives:

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

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

Course Content:

Unit 1 Listening Skills

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

Unit II Introduction to Phonetics

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.
2. James Hartman& et al. Ed. *English Pronouncing Dictionary.* Cambridge: Cambridge University

Press, 2006.

3. Kulbhushan Kumar, Effective Communication Skills, Khanna Publishing House, New Delhi (Revised Ed. 2018)
4. J.D.O'Connor. *Better English Pronunciation.* Cambridge: Cambridge University Press, 1980.
5. Lindley Murray. *An English Grammar: Comprehending Principles and Rules.* London: Wilson and Sons, 1908.
6. Margaret M. Maison. *Examine your English.* Orient Longman: New Delhi, 1964.
7. J.Sethi & et al. *A Practice Course in English Pronunciation*. New Delhi: Prentice Hall, 2004.
8. Pfeiffer, William Sanborn and T.V.S Padmaja. *Technical Communication: A Practical Approach*. 6th ed. Delhi: Pearson, 2007.

Learning Outcome:

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

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Semester - II

Course Code	:	BS102
Course Title	:	Mathematics - II
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	BS

Course Objectives:

This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, 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 $\int_0^{\frac{\pi}{2}} \sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} \cos^n x\, dx$ and $\int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\, dx$ 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. S.S. Sabharwal, Sunita Jain, Eagle Parkashan, Applied Mathematics, Vol. I & II, Jalandhar.
4. Comprehensive Mathematics, Vol. I & II by Laxmi Publications, Delhi.
5. Reena Garg & Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishing House, New Delhi

Course Outcomes:

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

(i) the students are expected to acquire necessary background in Determinants and Matrices so as to appreciate the importance of the Determinants are the factors that scale different parameterizations so that they all produce same overall integrals, i.e. they are capable of encoding the inherent geometry of the original shape.

(ii) the cumulative effect of the original quantity or equation is the Integration

(iii) the coordinate geometry provides a connection between algebra and geometry through graphs of lines and curves.

(iv) Tell the difference between a resultant and a concurrent force to model simple physical problems in the form of a differential equation, analyze and interpret the solutions.

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Course Code	:	BS104
Course Title	:	Applied Physics -II
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	High School Level Physics
Course Category	:	BS

Course Objectives

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

Teaching Approach

Teachers should give examples from daily routine as well as, engineering/technology applications on various concepts and principles in each topic so that students are able to understand and grasp these concepts and principles. In all contents, SI units should be followed.

Use of demonstration can make the subject interesting and develop scientific temper in the students. Student activities should be planned on all the topics.

Activity- Theory - Demonstrate / practice approach may be followed throughout the course so that learning may be outcome and employability based.

Course Content

UNIT - 1: Wave motion and its applications

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

Simple Harmonic Motion (SHM): definition, expression for displacement, velocity, acceleration, time period, frequency etc. Simple harmonic progressive wave and energy transfer, study of vibration of cantilever and determination of its time period, Free, forced and resonant vibrations with examples.

Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications, Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.

UNIT - 2: Optics

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

Optical Instruments; simple and compound microscope, astronomical telescope in normal adjustment, magnifying power, resolving power, uses of microscope and telescope, optical projection systems.

UNIT - 3: Electrostatics

Coulombs law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

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

UNIT - 4: Current Electricity

Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and colour coding.

Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications (slide wire bridge only), Concept of terminal potential difference and Electro motive force (EMF)

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

UNIT - 5: Electromagnetism

Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization.

Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in mag-

netic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field.

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

UNIT - 6: Semiconductor Physics

Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped).

Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only).

Photocells, Solar cells; working principle and engineering applications.

UNIT - 7: Modern Physics

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

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

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

Learning Outcome:

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

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

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

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

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

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

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

g) Express electric current as flow of charge, concept of resistance, measure of the parameters: electric current, potential difference, resistance.

h) List the effects of an electric current and its common applications, State Ohm's law, calculate the equivalent resistance of a variety of resistor combinations, distinguish between AC and DC currents, determine the energy consumed by an appliance,

i) State the laws of electromagnetic induction, describe the effect on a current-carrying conductor when placed in a magnetic field.

j) Explain the operation of appliances like moving coil galvanometer, simple DC motors.

k) Apply the knowledge of diodes in rectifiers, power adapters and various electronic circuits. Use the knowledge of semiconductors in various technical gadgets like mobile phones, com-

puters, LED, photocells, solar lights etc.

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

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

n) Express importance of nanoscience and nanotechnology and impact of nanotechnology to the society.

References:

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

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Course Code	:	ES 102
Course Title	:	Introduction to IT Systems
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	ES

Course Objectives::

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

Course Content:

UNIT 1:

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, Keyboard, 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.

UNIT 5: Information security best practices.

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

Suggested Lab Work:

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

References:

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

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.

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Course Code	:	ES104
Course Title	:	Fundamentals of Electrical and Electronics Engineering
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives:

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

Course Content:

UNIT I Overview of Electronic Components & Signals:

Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.

UNIT II Overview of Analog Circuits:

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

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

Unit IV Electric and Magnetic Circuits:

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

Unit V A.C. Circuits:

Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

Unit VI Transformer and Machines: General construction and principle of different type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations and characteristic of motors.

References:

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

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Course Code	:	ES 106
Course Title	:	Engineering Mechanics
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	NIL
Course Category	:	ES

Course Objectives:

Following are the objectives of this course:

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

Course Contents:

Unit – I Basics of mechanics and force system

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

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

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

Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.

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

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

Unit– II Equilibrium

Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical methods of analysing equilibrium

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

Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, uniformly distributed load, couple),

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

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

Unit– III Friction

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

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

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

Unit– IV Centroid and centre of gravity

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

Centroid of composite figures composed of not more than three geometrical figures

Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) Centre of Gravity of composite solids composed of not more than two simple solids.

Unit – V Simple lifting machine

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

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

Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block.

Suggested Learning Resources:

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

Course outcomes:

After completing this course, student will be able to:

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

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

Course Objectives:

Concrete use of physical principles and analysis in various fields of engineering and technology is very 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.

List of Practicals/Activities: (To perform minimum 12 Practicals)

1. To determine and verify the time period of a cantilever.
2. To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.
3. To verify laws of reflection from a plane mirror/ interface.
4. To verify laws of refraction (Snell's law) using a glass slab.
5. To determine focal length and magnifying power of a convex lens.
6. To verify Ohm's law by plotting graph between current and potential difference.
7. To verify laws of resistances in series and parallel combination.
8. To find the frequency of AC main using electrical vibrator.
9. To verify Kirchhoff's law using electric circuits.
10. To study the dependence of capacitance of a parallel plate capacitor on various factors and determines permittivity of air at a place.
11. To find resistance of a galvanometer by half deflection method.
12. To convert a galvanometer into an ammeter.
13. To convert a galvanometer into a voltmeter.
14. To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.
15. To verify inverse square law of radiations using a photo-electric cell.
16. To measure wavelength of a He-Ne/diode laser using a diffraction grating.
17. To measure numerical aperture (NA) of an optical fiber.
18. Study of an optical projection system (OHP/LCD) - project report.

Suggested Student Activities & Strategies

Apart from classroom and laboratory learning following are the suggested student related activities which can be undertaken to accelerate the attainment of various outcomes of the course.

a. Make survey of different physical products and compare the following points
   - Measurements of dimensions
   - Properties
   - Applications
b. Library survey regarding engineering materials/products used in different industries
c. Seminar on any relevant topic.

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler or descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations/projects.
- Micro-projects on relevant may be given to group of students for hand-on experiences.

Learning Outcome:

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

a) Apply concept of vibrations and determine the time period of vibrating objects.

b) Use of equipment for determining velocity of ultrasonics in different liquids.

c) Verify optical laws; reflection, refraction from plane interfaces and surfaces.

d) Apply knowledge of optics to determine focal length and magnifying power of optical lenses.

e) Understand uses of electrical components and meters and verify Ohm's law for flow of current.

f) Quantify resistances and verify laws of series and parallel combination of resistances.

g) Apply concept of electrical vibrations in determine frequency of AC main.

h) Analyse electrical circuits and verify Kirchhoff's law governing electrical circuits.

i) Measure resistance of a galvanometer and how it is converted into an ammeter and voltmeter.

j) Investigate characteristics of semiconductor diodes, photoelectric cells and determine operational parameters associated with their performance.

k) Work with laboratory lasers and understand method to measure the wavelength of the light emitted from a laser.

l) Handle optical fibers and determine numerical aperture of given optical fiber.

m) Understand construction and working of an optical projection system.

Recommended Books:

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

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

Course Objectives:

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

Course Content:

S.No.	Topics for Practice
1	Browser features, browsing, using various search engines, writing search queries
2	Visit various e-governance/Digital India portals, understand their features, services offered
3	Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognise various ports/interfaces and related cables, etc.
4	Install Linux and Windows operating system on identified lab machines, explore various options, do it multiple times

5	Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6	Practice HTML commands, try them with various values, make your own Webpage
7	Explore features of Open Office tools, create documents using these features, do it multiple times
8	Explore security features of Operating Systems and Tools, try using them and see what happens.

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

References:

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

Course outcomes:

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

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

Suggested Practicals/Exercises:

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

S. No.	Practical Outcomes (PrOs)	Approx. Hrs.
1.	Determine the permeability of magnetic material by plotting its B-H curve.	02*
2.	Measure voltage, current and power in 1-phase circuit with resistive load.	02*
3.	Measure voltage, current and power in R-L series circuit.	02*
4.	Determine the transformation ratio (K) of 1-phase transformer.	02
5.	Connect single phase transformer and measure input and output quantities.	02
6.	Make Star and Delta connection in induction motor starters and measure the line and phase values.	02
7.	Identify various passive electronic components in the given circuit	02
8.	Connect resistors in series and parallel combination on bread board and measure its value using digital multimeter.	02
9.	Connect capacitors in series and parallel combination on bread board and measure its value using multimeter.	02*

S. No.	Practical Outcomes (PrOs)	Approx. Hrs.
10.	Identify various active electronic components in the given circuit.	02
11.	Use multimeter to measure the value of given resistor.	02
12.	Use LCR-Q tester to measure the value of given capacitor and inductor.	02
13.	Determine the value of given resistor using digital multimeter to confirm with colour code.	02*
14.	Test the PN-junction diodes using digital multimeter.	02*
15.	Test the performance of PN-junction diode.	02
16.	Test the performance of Zener diode.	02
17.	Test the performance of LED.	02
18.	Identify three terminals of a transistor using digital multimeter.	02
19.	Test the performance of NPN transistor.	02*
20.	Determine the current gain of CE transistor configuration.	02
21.	Test the performance of transistor switch circuit.	02
22.	Test the performance of transistor amplifier circuit.	02
23.	Test Op-Amp as amplifier and Integrator	02
	Total	**46**

References:

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

Suggested Softwares/Learning Websites:

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

g. www.technologystudent.com/elec1/transis1.htm
h. www.learningaboutelectronics.com
i. www.electrical4u.com

Course Outcomes:

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

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

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

Course Objectives::

Following are the objectives of this course:

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

List of Practical to be performed:

1. To study various equipments related to Engineering Mechanics.
2. To find the M.A., V.R., Efficiency and law of machine for Differential Axle and Wheel.
3. To find the M.A., V.R., Efficiency and law of machine for Simple Screw Jack.
4. Derive Law of machine using Worm and worm wheel.
5. Derive Law of machine using Single purchase crab.
6. Derive Law of machine using double purchase crab.
7. Derive Law of machine using Weston's differential or wormed geared pulley block.
8. Determine resultant of concurrent force system applying Law of Polygon of forces using force table.
9. Determine resultant of concurrent force system graphically.
10. Determine resultant of parallel force system graphically.
11. Verify Lami's theorem.
12. Study forces in various members of Jib crane.
13. Determine support reactions for simply supported beam.
14. Obtain support reactions of beam using graphical method.
15. Determine coefficient of friction for motion on horizontal and inclined plane.
16. Determine centroid of geometrical plane figures.

Suggested Learning Resources:

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

Course outcomes:

After completing this course, student will be able to

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

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

Course Objectives:

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

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

Course Content:

Pre requisite: - High School Chemistry

Unit-1 Ecosystem

Structure of ecosystem, Biotic & Abiotic components

Food chain and food web

Aquatic (Lentic and Lotic) and terrestrial ecosystem

Carbon, Nitrogen, Sulphur, Phosphorus cycle.

Global warming -Causes, effects, process, Green House Effect, Ozone depletion

Unit– 2 Air and, Noise Pollution

Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler)

Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator)

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

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

Unit- 3 Water and Soil Pollution

Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation

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

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

Unit– 4 Renewable sources of Energy

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

Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas.

Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy.

New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy

Unit-5 Solid Waste Management, ISO 14000 & Environmental Management 06 hours

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

Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries.

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

Air quality act 2004, air pollution control act 1981 and water pollution and control act1996.

Structure and role of Central and state pollution control board.

Concept of Carbon Credit, Carbon Footprint.

Environmental management in fabrication industry.

ISO14000: Implementation in industries, Benefits.

References:

(a) Suggested Learning Resources:

Books:

1. S.C. Sharma & M.P. Poonia, Environmental Studies,Khanna Publishing House,NewDelhi
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.

3. Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and
4. Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-
5. Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000, ISBN 10: 0471144940.
6. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
7. Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
8. Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07-451871-8.
9. Frank Kreith, Jan F Kreider, Principles of Solar Engineering, McGraw-Hill, New York ; 1978, ISBN: 9780070354760.
10. Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford, UK; 2013. ISBN: 9780123978257.
11. Patvardhan, A.D, Industrial Solid Waste, Teri Press, New Delhi, 2013, ISBN:978-81-7993-502-6
12. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
13. Keshav Kant, Air Pollution & Control, Khanna Publishing House, New Delhi (Edition 2018)

(b) Open source software and website address:

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

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/sub topics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to group of students for hand-on experiences
- Encouraging students to visit to sites such as Railway station and research establishment around the institution.

Course outcomes

At the end of the course student will be able to

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

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Syllabus for

Diploma in Metallurgy

(Semester 3 to Semester 6)

Department of Materials Science & Metallurgical Engineering
UIET, School of Engineering and Technology,
CSJM University, Kanpur

SEMESTER - 3

DM – 301: BASIC METALLURGY

1. **Nature of Solids:**

   States of matter, types of structures, atomic structure of metals, allotropy, and Miller indices for planes and directions. Imperfections in crystals of point, line and surface. Structures of silicates, carbon and glasses. Polymeric structures.

2. **Pyrometry:**

   High temperature scales, primary and secondary standards, principles of thermochemistry, Seeback effect, Peltiers and Thompson effect. Thermocouples: composition, temperature ranges, environmental conditions, preparation and calibration of thermocouples. Pyrometers black-body-radiation laws, Emissivity, optical and Radiation pyrometers. Subzero temperature measurements, applications of different pyrometers. Study of temperature controllers.

3. **Vacuum Measurement:**

   Introduction, principle, Measurement and application of vacuum in metallurgy.

4. **Refractory Materials:**

   Classification, Properties and applications of fire clay, silica, magnesite, chromite, carbon and special refractories like insulating materials, fused silica, alumina, and zirconia.

5. **Solid Fuels :**

   Classification of fuels, solid fuels, occurrence of coal with reference to Indian conditions. Classification of coals, proximate and ultimate analysis of coal , carbonisation of coal, properties of coke, bi-products of coke ovens, properties of Indian coal and coke, uses of pulverized and briquetted coal or coke.

6. **Liquid and Gaseous Fuels and Furnaces :**

   Liquid fuels - important properties and uses of Liquid fuels. Gaseous fuels - composition, properties and uses of Natural Gas, Blast furnace Gas, Coke oven gas, and Liquefied Petroleum gases. Introduction to burners. Furnaces - Basic types of furnaces used in industries, refractories used in furnaces, different fuels used in furnaces.

DM – 301P: BASIC METALLURGY LAB

Laboratory Work :

1. Determination of Porosity of refractories.
2. Practical on Proximate analysis of coal and coke.
3. Measurement of Viscosity of Oil.
5. Determination of Calorific value of fuels.
6. Measurement of flash & fire point of fuels.
7. Study and sketching of different structures directions and planes
8. Study of resistance thermometer
9. Study of radiation pyrometer
10. Study of optical pyrometer.
11. Study of temperature controller.

References:

1. Introduction to Physical Metallurgy by S.H. Avner.
2. Engineering Metallurgy part I and II by Raymond A. Higgins
3. Refractories by A. Rashid Cheste
4. Refractories by Dr. Mishra M.L.
5. Fuels, Furnaces and Refractories by J.D. Gilchrist.
6. A text book of Engineering Chemistry by M.M. Uppal
7. Material science and process by Hazara Choudhary.
8. Refractories by F.H. Norton.

DM – 302: TESTING OF MATERIALS

1. Elasticity

Stress, strain, definition of elastic and plastic bodies, strain under axial load in tension and compression. Temperature stress. Hook's law -Relation between linear strain and normal stress. Modulus of elasticity / Young's modulus.

2. Mechanical Testing:

Tensile test, scope and applicability, specification of testing specimen. Conduct and observation of test, effect of important variables, Yield stress and proof stress determinations, Types of tensile testing machine & their construction.

1. Universal testing machine.
2. Extensometer and recorders, strain gauges.

3. Hardness Test :

Scope and applicability, Constructional principles of common hardness machines. Brinell test: Procedure, effect of variables. Rockwell test : procedure. Rockwell Superficial hardness tester. Vickers hardness test, Microhardness tester. Shore Sceleroscope, scratch and wear hardness test. Relation between various systems of hardness numbers. Relation of hardness to tensile strength.

4. Service Tests :

Impact test : Behavior of material under impact loading, Charpy and Izod impact tests. Calculation of energy relation, brittle fracture. Effect of variables. Role of temperature and stress concentration factors like holes, cracks etc. **Fatigue test**: Repeated loading. Nature of fatigue in metal, Scope and applicability of fatigue test. Machine for fatigue test on metals, general procedure. Effect of important variables. Correlation with other properties. Study of S-N Curve. **Creep test** : Nature of Creep, Scope and applicability of creep test. Creep apparatus. Rupture test. Factors Influencing Creep.

5. Non-Destructive Testing :

Need of Non-destructive test, Types of non-destructive test, Methods of Examination for defects: Visual examination, Penetrant tests, Hammer tests etc. Method of Electrical analysis: Sperry detector for flaws in rails and in tubes Electromagnetic steel sorter. Method of magnetic analysis: Magnetic particle method. Radiographic Examination : X-ray and

Gamma ray generation and their practical application in radiography. Comparison of X-ray and gamma ray radiography. Equipments for X-ray and gamma rays. Radiograph and effect of important variables, requirement for good radiograph. Interpretation of radiograph, Safety precautions. Ultrasonic Testing: Fundamentals, Equipments and applications. Introduction to IN-SITU metallography, spark testing and Eddy current testing

DM – 302P: TESTING OF MATERIALS LAB

Laboratory Work:

1. Determination of Tensile strength on U.T.M.
2. Measurement of Hardness by :
   a) Brinell hardness tester.
   b) Vickers hardness tester.
   c) Rockwell hardness tester.
   d) Rebound hardness tester.
   e) Poldy impact hardness tester.
   f) Rockwell Superficial hardness tester.
3. Determination of Impact strength by Charpy / Izod impact tester.
4. Study of Fatigue test.
5. Practical on Magnetic Particle Crack detectors.
6. Practical on Ultrasonic flaw detector.
7. Study of Radiography.

References:

1. Testing of materials by Prof. A.V.K. Suryanarayana.
2. The Testing & Inspection of Engineering materials by H. E. Davis, G. E. Troxell,
3. Mechanical Metallurgy- George Dieter.

DM – 303: PHYSICAL METALLURGY

1. Solidification Of Metals:

Transformation of liquid in to solid, cooling curve, nucleation, dendrite formation, grain and grain boundaries, cooling curve for pure metals and binary alloys.

2. Phase Equilibrium Diagrams:

Definition of phase, Gibbs's phase rule and its application. Solid solutions - Substitutional solid solution, Interstitial solid solution, Terminal solid solution & Intermediate solid solution. Intermediate compounds, construction of equilibrium diagrams, viz., monotectic, eutectic, Peritectic, Eutectoid reactions, peritectoid reactions, coring defects.

3. Lever Rule :

Its derivation and application to equilibrium diagram Identification of microstructure of metals at different temperatures with respect to equilibrium diagram.

4. Iron Carbon Equilibrium Diagram:

Allotropic transformation of iron, Reactions in Iron- Carbon diagram , classifications, microstructure and properties of plain carbon steels and cast irons with reference to iron carbon diagram. , cooling of different carbon steels and cast irons.

5. Microscopic Examination:

1. Preparation, techniques & methods of sampling - Mechanical and electrolytic polishing - etching techniques and etching reagents. Analysis and interpretation of phases related to steel and cast iron

2. The metallurgical microscope and metallograph. Optical principles of metallurgical microscope. Optical system, objectives, eye pieces and properties etc. Microphotography, films properties, exposing, developing and printing.

6. Macroscopic Examination:

Principles and procedure of macroscopic examinations, etching reagents, sulphur printing, phosphorus printing, oxide printing etc. Etching reagents, grain / fibre flow of forged components.

7. Quantitative Metallography:

Measuring attachment on microscope, calibration measurement of grain size, ASTM grain size nos., measurement of case depth, plating, thickness, etc. Importance of phase distribution in microstructure and its effect on mechanical properties.

8. Metallurgy of Non-Ferrous Alloys:

1. Brasses- Cu-Zn equilibrium diagram, Brasses,microstructures- single phase and double phase brass , mechanical properties and application of commonly used industrial brasses.
2. Bronzes: Cu-Sn equilibrium diagram, cast dendritic structure, composition, microstructure, mechanical properties and application of commonly used industrial bronzes- Gun metal and phosphor bronze
3. Al Alloys: Al-Si equilibrium diagram, cast and modified structures of Al-Si alloys, compositions of commonly used as cast and as wrought Al-Si Alloys.
4 Bearing metals: Classification of bearing metals, requirements of good bearing metal.. Composition, microstructure, mechanical properties and applications of Lead base and Tin base bearing metals & effects of copper addition.

DM – 303P: PHYSICAL METALLURGY LAB

Laboratory Work:

1. Preparation of sample for microscopic examination.
2. Practical on mounting press.
3. Study of etching techniques.
4. Practical on Electrolytic polishing & etching.
5. Study of metallurgical microscope.
6. Practical on Microscopic Examination.
7. Experiment on Measurement of ASTM grain size.
8. Study of Microstructures of ferrous & non-ferrous metals & alloys.
9. Practical on sulphur printing.
10. Practical on phosphorous printing.
11. Practical on oxide printing.
12. Practical on Microphotography.

References :

1. Introduction to Physical Metallurgy by S.H. Avner.
2. Metallurgy for Engineers by Clark & Varney

3. Metallurgy for Engineers by E.C. Rollason.
4. Engineering Physical Metallurgy by Y. Lakhtin.
5. Metallurgical Laboratory practice by Dr. KHEL
6. Physical metallurgy vol. I by Dr, P.R. Khangaonkar.
7. Engineering metallurgy Part I. by Raymond. A. Higgins.
8. Modern Physical Metallurgy by R. E. Smallman.
9. ASM Metals Handbook Volume 8.

DM – 304: METALLURGICAL THERMODYNAMICS

1. Introduction

Classical Thermodynamics, Introductory Concepts and Definitions - System and Surrounding, State of a System, Thermodynamic Equilibrium, Characterization of Systems

2. First Law of Thermodynamics

Internal Energy, Statement of the First Law, Reversible Processes, Enthalpy, Heat Capacity, Ideal Gases - Adiabatic Expansion and Compression, Work Done in Reversible Adiabatic Expansion

3. Heat Capacity and Enthalpy

Heat Capacity of Ideal Gases, Heat Capacity of Solids, Enthalpy and Enthalpy Changes

4. Second Law of Thermodynamics and Entropy

Statements of the Second Law, Carnot Cycle, Thermodynamic Temperature Scale, Entropy, Calculation of Entropy Changes, Second Law and Entropy

5. Auxiliary Functions and Relations, Criteria for Equilibrium

Free Energy, Combined Expressions of First and Second Laws of Thermodynamics, Maxwell's Equations, Criteria for thermodynamic Equilibria, Criteria for reversible Processes

6. Gibbs Free Energy, Activity, Equilibrium Constant

Gibbs-Helmholtz (G-H) Equations, Clapeyron Equation, Fugacity and Activity of a Component in a Solution, Equilibrium Constant (K) for a Chemical Reaction, Ellingham Diagrams

7. Thermodynamics of Solutions

Ideal and Non ideal Solutions, Properties of Solutions, Regular and Non-regular Solutions, Quasi-chemical Theory of Solution.

8. Third Law of Thermodynamics

Nernst Heat Theorem, Entropy of a Pure Substance, Fundamental Significance of the Third, Experimental Verification of the Third Law.

9. Thermodynamics of Defects in Solids

Surfaces and Interfaces of Solids, Vacancies and Interstitials in Solid Metals

References :

1. Introduction to Thermodynamics, Y. V. C. Rao
2. Textbook of Materials and Metallurgical Thermodynamics, A. Ghosh (PHI)

DM – 305: IRON MAKING

1. Raw Materials and Burden Preparation for Iron Making:

Introduction to integrated steel plant, Types of iron ores and its valuation, fuels and fluxes required-their properties, functions and applications. Beneficiation of iron ore, Agglomeration- principle and process of sintering and palletisation.

2. Blast Furnace Construction:

Furnace details - hearth, bosh, stack, etc, refraciories used, hot blast stove, gas cleaning plant, burden charging systems.

3 Blast Furnace Operation:

Working principle of blast furnace, chemical reactions in the different zones of blast furnace, efficiency of blast furnace, irregularities and their remedies in blast furnace operation, modern trends in blast furnace.

4. Sponge Iron Production:

lternative routes of iron production -sponge iron production- Hyl process, midrex process and rotary kiln process. Sponge iron making in India and use of sponge iron.

References:

1. Modern Iron Making: By- Dr. R.H. Tupkari
2. Elements of Metallurgy: By-Dr.. Swaroop & Dr. M. N. Saxena.
3. General Metallurgy: By- Kuznestsov

4. Extractive Metallurgy: By-Dennis

DM – 306: HEAT TREATMENT OF METALS

1. General Aspects of Heat-Treatment:

Principle of heat treatment, Role and importance of heat treatment in the industry.

1. Transformation of pearlite into Austenite on slow heating, effect of grain size. Determination of austenite grain size in steel.
2. Transformation of austenite into pearlite - Nucleation and growth of cementite and ferrite, effect of time, grain size etc.

2. Isothermal Transformation of Austenite :

S-curve, T.T.T. diagram, construction of T.T.T. diagram from transformation curves. Use of T.T.T. diagram for determining H.T. cycles- characteristics of martensitic transformation - Ms- Mf temp. - Retained austenite - effect of carbon and alloying elements - C.C.R.- effect of austenitic grain size. Volumetric changes during martensite transformation, Bainite formation and properties. Transformation of austenite on continuous cooling - C.C.T. diagram. Effect of alloying elements on Iron - carbon diagram and T.T.T. diagram - its effect on Heat - treatment cycles.

3. Hardenability of Steel:

Actual cooling curve after quenching stages in cooling severity of quench, quenching medium - hardenability - factors affecting hardenability - Determination of hardenability of steel. Grossman method and Jominy end quench test - determination of ideal critical diameter Use of hardenability data in industry

4. Heat Treatment Processes:

Reheating of steel- Heating time- Oxidation and decarburisation - furnace atmosphere and control.

1. Annealing & normalising - comparison of two process microstructural changes - Types of annealing treatments -Recrystallisation annealing, stress relieving - annealing, full annealing, black, blue, bright, close and vacuum annealing.
2. Hardening:- Purpose of hardening - selection of hardening temp. - methods of quenching - quenching mediums . Retained austenite - sub-zero treatment.

3. Tempering - purpose of tempering - stages in tempering - effect of temp., and time on structure - temper embrittlement.
4. Spheroidising of steel -pendulum annealing - high temp. tempering - properties and uses.
5. Types of H.T. based on T.T.T. diagram - Austempering, Martempering, Ausforming, Patenting, and maraging of steel.
6. Case hardening of steel-carburising, H.T. after carburising, cyaniding, Nitriding, Tufftriding, steels used for above processes. Diffusion metallising processes, Sursulf process.
7. Surface hardening of steel.
    1. Induction hardening - principle, equipments and steels used.
    2. Flame hardening - principle, equipments and steels used.
8. Heat Treatment defects, causes and remedies

5. Heat Treatment of Cast Irons:

Annealing, stress relieving, malleablising - H.T., H.T. of High duty cast irons & S.G. Iron.

6. Heat - Treatment of Non - Ferrous Alloys:

1. Al bronze: Cu-Al equilibrium diagram Hardening of Al bronze.
2. Precipitation hardening - Al-Cu equilibrium diagram.

DM – 306P: HEAT TREATMENT OF METALS LAB

Laboratory Work:

Student should maintain a journal by conducting minimum 10 experiments from the list given below.

1. Experiment on Annealing of steel.
2. Experiment on Normalising of steel.
3. Experiment on Hardening - effect of C%
4. Experiment on Hardening - effect of temp.
5. Experiment on Hardening - effect of quenching medium.
6. Experiment on Tempering - effect of time.
7. Experiment on Tempering - effect of temp.
8. Experiment on Spheroidising - pendulum annealing.

9. Experiment on Spheroidising - high temp.
10. Experiment on Carburising and hardening.
11. Experiment on Hardenability - Jominy's test.

References:

1. Engineering Physical Metallurgy by Y. Lakhtin.
2. Introduction to Physical Metallurgy by S.H. AVNER.
3. Metallurgy for Engineers by Clark and Varney.
4. Heat Treatment of Metals & Alloys by Zakarov.
5. ASM Metals Hand Book Vol. 2.
6. Metallurgy for Engineers by E. C. Rollason.
7. Bofors Hand book on Heat Treatment.

SEMESTER - 4

DM – 401: METAL WORKING – 1

1. Plastic Deformation:

Objectives and classification of metal working processes. Workability of materials, Plastic deformation, modes of plastic deformation, Critical resolved shear stress, Work hardening, Cold worked- annealed cycle, Cold Working and Hot working. Recovery, Recrystallisation and grain growth. Intermediate annealing.

2. Rolling of Metal

Principle of metal rolling Rollling Mills, classification construction in brief plant layout, hot rolling, cold rolling, Parameters in rolling, derivation of angle of bite, typical roll pass design and roll pass sequences for blooms, Billets, rods and flat products, Defects in rolled products and their remedies. Ausforming, HTMT and LTMT.

3. Forging of Metal

Forging principles, open die and closed die forging, heating for forgings, forging forgings dies, Forging defects, and residual stresses in forgings. Plant Layout, High energy rate Forging technique, hand forging operations, working principles of following Hammers and presses for forging: Stem Hammner, Pneumatic Hammer, Board drop Hammer, Spring Hammer, Mechanical Press, Hydraulic Press.

4. Extrusion of Metal:

Deformation in extrusion, extrusion Machines, Direct and Indirect extrusion, Extrusion equipments, dies, lubricants. Extrusion defects. Impact extrusion, Hydrostatic extrusion. High velocity rate extrusions, extrusion pressure and parameters affecting on it Aluminium extrusion - Architectural use with plant lay out.

DM – 401P: METAL WORKING – 1 LAB

Laboratory Work:

1. To study the effect of Plastic deformation on Properties & structure of Metallic Materials.
2. Study of Rolling Mills
3. To study the effect of Rolling on the Properties & structure of Metallic Materials

4. To study the effect of Forging on the Properties & structure of Metallic Materials
5. Study & sketching of Forging Hammers, Presses, Punches & Dies
6. To study the various types of Extrusion processes.

References:

1. Metallurgical Processes by Campbell.
2. Engineering metallurgy part II by Raymond A. Higgins.
3. Press working by Shukhov & Elenyev.
4. Mechanical metallurgy by George Dieter.
5. Making, Shaping & Treating of Steels-U.S. Steels.

DM – 402: STEEL MAKING

1. **Steel Making:**

   Raw materials for steel making -sources of metallic iron, oxidising agents, fluxes, sources of heat, deoxidisers, furnace refractories. Principles of steel making- carbon, phosphorous, sulphur reactions, etc. Efficiency of steel making processes. Present status of iron and steel industries in India.

2. **Steel Making Processes:**

   Principles, important constructional details, process details, outline, merits and demerits of Bessemer, Open-hearth furnace. Side blown converter, oxygen steel making - L.D. Converter.

3. **Electric Steel Making:**

   Electric are furnace constructional details, charge, and materials. Process detail, Induction furnace, and principles of heating process merits and demerits of process.

4. **Secondary Steel Making Process:**

   Synthetic slag refining, Decarburisation techniques-AOD, VOD, CLU. ESR and VAR process, ladle furnace, merits of secondary steel making process.

5. **Vaccum Treatment of Steel:**

   Principles, Sieverts law, degassing processes, ladle degassing, stream degassing, recirculation degassing.

6. **Continuous Casting of Steel:**

   Principle, Construction and outline of processes. Merits, Demerits and Applications.

References :

1. Modern Iron Making : By- Dr. R.H. Tupkari
2. Modern steel Making : By-Dr. R.H. Tupkari
3. Elements of Metallurgy : By-Dr. D. Swaroop & Dr. M. N. Saxena.
4. General Metallurgy : By - Kuznestsov.
5. Extractive Metallurgy : By - Dennis.
6. Steel making- by Bashforth.

DM – 403: EXTRACTIVE METALLURGY (NON – FERROUS)

1. Introduction:

Classification and sources of Metals, Minerals, Ores etc. Principles of roasting, calcination, etc and comparison of Pyrometallurgy, Hydrometallurgy and Electrometallurgy.

2. Preparation of Ores:

Crusher classification, and their characteristics. Crusher's classifications with requirement, study and use of jaw crushers, gyratory crushers, cone crusher and quality stamp mill, sizing techniques, Sizing scales, Grinding: Ball mill, rod mill & tube mill, and classification, Comminution principle of process. Laws of Comminution. Froth floatation technique.

3. Extraction of Non-Ferrous Metals:

1. Copper:

Ores of Copper, production of Cu from sulphide/complex ores. Refining of Copper, Hydrometallurgy of copper.

2. Aluminium:

Sources of Aluminium, extraction of Aluminum by Bayer's process. Preparation of Cryolite and carbon electrodes. Aluminium cell, construction working composition and properties of bath, anode effect, refining of aluminium.

3. Lead and Zinc:

Ores, extraction of lead and Zinc. Complete ore treatment for lead and tin.

4. Uranium and Thorium:

Sources in India & recovery of U and Th from their minerals. Importance and uses of Uranium and thorium.

References:

1. Mineral dressing - A.M. Gaudin
2. Extraction of Non-Ferrous Metals by K. S. Roy, P. Sri & K.P. Abraham.
3. Extractive Metallurgy - R. S. Rosengwest
4. General Metallurgy - By Kuznestsov
5. Elements of Metallurgy-By Dr. D. Swaroop & Dr. M. N. Saxena

DM – 404: METALLURGICAL ANALYSIS

1. Introduction:

Sampling of Ores, Metals and alloys and other metallurgical important products. Lay out of chemical laboratory and equipments in chemical laboratory. Important chemicals required in metallurgical chemical laboratory and preparation of dilute and standard solutions. Law of mass action, Quantitative & Qualitative Analysis. Errors in quantitative determination their causes and remedies.

2. Gravimetric Analysis:

Chemical balances and their precision -adjustment of chemical balance Solubility product rule, requirements of precipitate precipitated and weighed form. Effect of excess precipitant, temperature, salt effect, PH on completion of precipitation. Co-Precipitation and masking, filtration, drying and ignition of precipitate-weighing the reaction products for determining percentage.

3. Volumetric Analysis:

Advantages of volumetric method, Normal and molar solutions - use of empirical solutions in routine analysis. Standardization of solutions Indicators and their properties requirements of reactions in volumetric methods. Titration of acid and alkaline solutions titration curves titration of oxidizing and reducing solutions. Preparation and standardization of KMnO4, HCI and NaOH solutions.

4. Instrumental Methods:

These methods of chemical analysis include spectroscope - principle and interpretation of spectrograph and its application. Electro- gravimetric analyzer -its operation and application, photo - colorimetriy its operation and application. Carbon & sulphur determination by combustion method - instrument and its operation. Use of pH meter in chemical analysis.

5. Fire-Assay Principles & Quantitative Determinations:

Fire-Assay principles - Methods of Silver & Gold Determination from ores. Preparation of standard solutions - Quantitative determinations of Mn and carbon in steel, Si, S, P in steel and Ni-Cr-Mo ,W & V in alloy steel, Cu and Zn in Brass, Cu & Sn in Bronze, Pb-Sn-Sb in white metal. Analysis of iron ore for determining Fe.

DM – 404P: METALLURGICAL ANALYSIS LAB

Laboratory Work:

1. Preparation of standard solution.
2. Quantitative determination of carbon and manganese in steel
3. Study strohlein (C-S determination) apparatus
4. Determination of C, S, P, Si in steel and cast iron.
5. Determination of Ni, Cr, Mo, in low alloy steel and W in high alloy steel.
6. Determination of Cu, Zn, in brass.
7. Determination of Cu,Tin, in bronze.
8. Determination of Pb-Sn i - Sbi white metal
9. Analysis of iron ore for determining Fe.
10. Study of instrumental methods for chemical analysis.

References:

1. Quantitative analysis by V. ALEXEYEV
2. A Text Book of Metallurgical Analysis by B.C AGARWAL AND S. P. JAIN

DM – 405: ELEMENTS OF FOUNDARY TECHNOLOGY

1. Pattern Making:

Production of patterns, difference between pattern and casting. Choice of pattern materials, type of patterns, pattern design considerations. Pattern allowances, pattern layout, pattern construction, and ISI colouring code on pattern, storing of pattern, core print fillets on pattern.

2. Core and Core Making:

Core sand, core sand properties. Ingredients, core materials, core sand mixture, core making machines, core baking and machining operations on cores. Core setting and location of cores, core shifting and chaplets, types of cores. Core applications & construction of core box.

3. Mould and Mould Making:

Moulding sands, Moulding sand binders, water, additives, properties of moulding sands, types of sands used in moulds, mould surface coating, moulding sand preparation & conditioning. Sand - Muller, moulding sand mixture for casting different metals and alloys. Indian sands, sand reclamation, mould characteristics, types of mould, moulding methods, hand moulding tools, moulding box or flasks, mould making machines, methods of ramming - moulding boxes, making moulds, venting of moulds, mould -metal reaction, sand control tests, typical green and dry sand composition for Cast Iron and steel.

4. Solidification of Castings, Gating and Risering

Concept of solidification of metals, nucleation & growth, mechanism of Dendrite formation, Dendritic growth, solidification rate, time and Chvorinov's Rule. Progressive, Directional solidification and control of solidification to obtain sound casting. GATING system - requirements, function of the gating system, pouring cups basins & characteristics. Types of gates, pressurized and unpressurised gating systems. Elimination of slag and dross, calculation of down sprue, runner and gate area for given simple castings. RISER - Function of risers, types of riser, riser and directional solidification, increasing riser efficiency and promoting directional solidification, use of chills, riser shape & size.

5. **Melting Practice:**

Melting units –constructional details, control of chemical composition during melting, operational control of—Cupola, Electric Arc and Induction furnaces, Crucible furnaces. Charge calculations and numericals of cupola.

6. **Post Shake-Out Treatment of Casting:**

Surface cleaning treatments, sand blasting, shot blasting, tumbling barrel, fettling operation on castings,

7. **Casting of Important Industrial Metals and Alloys:**

Production methods, Melting furnaces used, Gating and Risering systems, Fettling methods of

Ferrous Metals:

a. Gray Iron
b. Malleable Iron
c. S. G. Iron
d. Steel

Non-Ferrous Metals:

a. Cu based Alloys
b. Al based Alloys

DM – 405P: ELEMENTS OF FOUNDARY TECHNOLOGY LAB

Laboratory Work:

1. Study of foundry tools.
2. Determination of moisture content in moulding sand by Infra-red bulb method
3. Determination of moisture content in moulding sand by Rapid moisture teller.
4. Determination of Permeability in moulding sand.
5. Determination on Clay content in moulding sand.
6. Study and sketches of various types of patterns.
7. Practical on Green sand mould making .
8. Determination of A.F.S. Fineness No. of sand by sieve analysis.
9. Practical on Mould and mould making.
10. Practical on Pouring and casting.

References:

1. A Text Book of Foundry Technology by M. Lal & O. P. Khanna.
2. Principles of metal castings - R. W. Heine and P.C. Rosenthal.
3. Foundry Technology by D. B. Goyal & Sinha.
4. Foundry Practice by W.H. Salmon & E.N. Simons.
5. Foundry Technology by Beeley.

DM – 406: PROFESSIONAL PRACTICE – I

The proposed activities under this course are as follows.

1. Planned industrial visits
2. Guest lecturers of expert on new topics and emerging areas related to his programme.
3. Developing interpersonal skills.
4. Group discussion and seminar presentations.
5. Self-promotion.
6. Collaboration.
7. Research skills.
8. Brainstorming and Creativity.
9. Health consciousness.
10. Time management.

SEMESTER – 5

DM – 501: METAL WORKING – II

1. Drawing of Wire and Rod:

Preparation of wire, rod for drawing, deformation of metal in drawing die. Effects, friction and die angle. Die material. Draw Benches and wire drawing machines, Defects in wire' heat treatment of wires

2. Tube Making and Spinning of Metals:

Tube making by extrusion, tube making by rolling

Principle of spinning of metals, manual spinning, advantages, Equipments and tools, lubrications, spinning ratio, internal and external spinning, spinning lathe.

3. Non Conventional Machining Methods:

Classifications of modern machining methods, Electrochemical machining and electrical discharge machining, principles of the processes, outline of method, construction of machines, requirement, applications and comparison of the two methods.

4. Sheet Metal Working:

Characteristics and properties of metal sheets for forming operations. Typical press tools and processes for sheet metal working, shear action in die cutting, clearance and its effects on cut edge, cutting forces. Component of typical press tools. Type of the presses used, their construction and advantages and disadvantages. Forming operations, blanking, bending, deep drawing, Stretch forming, Defects in sheet metal products.

DM – 501P: METAL WORKING – II LAB

Laboratory Work:

1. To study the die for draw bench and wire drawing machines
2. Practical on Draw bench machine & Wire drawing machine
3. Practical on Spinning Lathe.
4. To study and sketching of types of presses
5. Practical on mechanical press for Blanking, Piercing & deep drawing operations
6. Practical on Erichson's Cupping Test.
7. To study defects in sheet metal products.

References :

1. Metallurgical Processes by Campbell.
2. Engineering metallurgy part II by Raymond A. Higgins.
3. Press working by Shukhov & Elenyev.
4. Mechanical metallurgy by George Dieter.
5. Making, Shaping & Treating of Steels - U.S. Steels.

DM – 502: MATERIAL MANAGEMENT AND QUALITY CONTROL

1. Quality Control & Inspection

a. Statistics of Quality control, Mode, Mean, Medium. Frequency distribution, Standard deviation, Normal distribution, Sampling Techniques.

b. Use of Control Charts and other statistical sampling tables.

c. Principles of Measurement, Vernier Scales, Various types of gauges.

d. I.S.I Specifications: Their formulations & importance.

2. Quality Assurance:

a. Definition of Quality Assurance and Essentials of an effective Quality Assurance System.

b. Independence of Quality Assurance Department.

c. Establishment of Quality Standards

d. Written procedures.

e. Control of Document flow.

f. Maintaining Identity and Traceability of Materials

g. Non-conforming Material and corrective action.

h. Calibration of Equipment

i. Retention of Records

j. Personnel Training & Qualification

k. Control of purchased material

l. Periodic Audit

3. Materials Management

a. Classes of Materials scope of material control,

b. Scope of purchasing department,

c. Purchasing department,

d. Inventory control,

e. Ordering Procedures,

f. Materials identifications,

g. Physical inventory,

h. Store-room location,

i. Layout and facilities,

j. Introduction to production

k. Planning and control

4. Quality Control Methods In Metallurgical Shops

Various steps involved in Quality Assurance for Metallurgical shops such as Rolling Mill, Steel Melting Shops, Forging shop, Heat treatment shop and other Metallurgical Evaluation Tests.

5. Concept of ISO

Definition of ISO-9000 and TQM

Various standards of

ISO -9001

ISO - 9002

ISO - 9003

ISO - 9004

Complete procedural details of ISO-9000 and various steps involved there in. Introduction to IS 14000 series.

References :

1. The Testing and Inspection of Engineering materials by - H.V. Davis, G.E Troxell & T.C. Wiskocil.
2. Testing of Metallic materials by - A.V.K. Suryanarayana.
3. ASM- Metals Hand Book Vol. II Eight Edition
4. ISO -9000 by - Suresh Dalal.

5. Industrial oraganisation and management by - Bang & Sharma.
6. Production planning and control by - Samuel Eilon
7. Process of management by - Newman & Warren.

DM – 503: MINERAL DRESSING

1. Introduction of Mineral Dressing:

Ores, Minerals and their properties, mineral dressing.- definition, necessity and advantages, Recovery ratio of concentration, flow sheets for benefication.

2. Status of Mineral Beneficiation Industry In India:

Status of mineral benefication industry in India. Study of some representative practices with flow sheets.

3. Mineral Dressing Methods:

1. **Sampling** - its importance, methodology and equipment's used.
2. **Comminution** - primary, secondary and final size reduction units, their comparison in design performance and capacities, Reduction ratios, Laws of grinding and work index.
3. **Screening, sizing and classification** - Principles units and performance, thickeners, hydro cyclones, standards screening tests and graphical representation of results.
4. **Gravity concentration methods** - Jigging, tabling, Heavy media separation etc. their principles controlling factors in operation and selective applications.
5. **Floatation** - natural and artificial floatability, collectors, frothers, depressors, activators and modifiers, conditioning, variable in floatation units and representative practices of sulphide non - sulphide and non - metallic ores.
6. Principles of magnetic and electrostatic separation units used in practice and examples for industry.

DM – 503P: MINERAL DRESSING LAB

Laboratory Work:

1. Practical on Jaw crusher.
2. Practical on Roll crusher.
3. To study the process of Palletizing.

4. To Study the process of Sintering.
5. To Study the process of Froth - Floatation.
6. To Study the process of Tabling/Jigging.
7. Experiment on Rod Mill Practice.
8. Experiment on Ball Mill Practice.

References:

1. Elements of mineral dressing - A. M. Gaudin.
2. Principles of mineral Processing - A. J. Prayer.
3. Hand book of mineral dressing - Taggart.

DM – 504: Metallurgical Design

1. Heat Treatment:

1. Design Considerations for heat-treated parts.
2. Design of fixtures for the mass heat treatment of metallic parts in Salt bath.
3. Conduction, Convection and Radiation.
4. Selection of and Furnace calibration (9 points calibration) in heating and melting furnaces.
5. Calculations for heating elements for electrical furnaces, Salt bath furnaces.
6. Calculations of fuels, Calculations for the requirements of allied machinery for oil and gas fired furnaces.

2. Foundry:

1. Design of pattern, gating and risering etc. for industrial cast components.
2. Die and mould design for Special Casting processes like Die casting, Centrifugal casting etc.
3. Design of Cupola furnace from required melting rate.
4. Foundry layout.
5. Ferrous Mechanized foundry.
6. Non Ferrous jobbing foundry.

3. Metal Working:

1. Design of forging die and forge shop lay-out.
2. Simple design of rolling mill passes and sequence calculations.
3. Calculations of wire drawing passes, power required etc.
4. Rolling mill - layout.
5. Design of dies used for Extrusion and presswork, Electroplating plant layout.

4. Welding and Joining:

Design of different types of weld Joints.

5. Powder Metallurgy:

Design of different dies and punches for compaction, plant lay- out.

References:

1. ASM Metals Hand Books Vol. 1 to Vol. 15.
2. Fundamentals of Metal Casting by R.W. Flinn.
3. Fuels, Furnaces & Refractories by J. D. Gilchrist.
4. Mechanical Metallurgy by George Dieter.
5. Engineering Metallurgy Part I & Part II by Raymond A. Higgins.
6. Metallurgical Process by Campbell.
7. AWS Welding Handbook.
8. Powder Metallurgy by Sands and Shakespears.
9. Bofors Handbook on Heat Treatment.
10. Heat Treatment of Metals & Alloys by Zakarov.
11. ASM Hand book on Casting Design.

DM – 505: CORROSION AND SURFACE ENGINEERING

1. Mechanisms and Types of Corrosion

Definition of corrosion, Classification of corrosion, Polarization, Passivity, Principles of direct and Electrochemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms– Galvanic corrosion, Galvanic series- specific types of corrosion such as uniform, Pitting, Intergranular, Cavitations, Crevice, Fretting, Erosion and Stress Corrosion– Factors influencing Corrosion

2. Testing and Prevention of Corrosion

Corrosion testing introduction and techniques, procedures- Surface preparation, Exposure techniques, Standard expression for corrosion rate, Prevention of Corrosion Introduction,

Modifications of corrosive environment – Charging Mediums - Low temperature, decreasing velocity, removing oxygen, Charging concentration, Inhibitors– Cathodic Protection– Protective surface coatings.

3. **Corrosion Behavior of Materials**
   Corrosion of steels and alloy steels, Stainless steel, Aluminum and its alloys, copper and its alloys, Nickel and Titanium and its alloys, Magnesium and its alloys, Zinc and its alloys-corrosion of Polymers, Ceramics and Composite materials
4. **Surface Engineering for Wear and Corrosion Resistance**
   Diffusion Coatings– Electro and Electro less Plating– Hot dip coating– Hard Facing- Metal spraying Flame and Arc processes-Conversion coating –Selection of coating for wear and Corrosion resistance.
5. **Thin Layer Engineering Processes**
   Laser and Electron Beam hardening – Effect of process variables such as power and scan speed-Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating- Chemical vapor deposition – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating– Properties and applications of thin coatings.

Reference:

1. Corrosion Engineering, Fontana, Tata McGraw Hill,1985.

2. Manufacturing Engineering & Technology, Serope Kalpakjian, Addison Wesley Publishing Co; NewYork1995.

3. Corrosion Engineering Hand Book, 3rd Edition, Schweitzer. P. A., Marcel Decker,1996.

4. Corrosion, Hand Book2ndedition,Winston Revie. R. Uhlig, John Wiley, 2000.

5. Surface Engineering for Wear Resistance, Kenneth G.Budinski, Prenticehall,1988.

6. ASM Metals Hand Book – Vol.5, Surface Engineering,1996.

DM – 506: Minor Project

1. Project:

The Project work will be done by a group of max. 4 Students. The Students will Select a topic related to any course in their curriculum and will design and construct the required models, charts, and equipments to carry out test and trials. They will Submit a report of the work done by them in a suitable form. The project may consist of a market Survey or a literature Survey of recent developments in the field of Metallurgy or it may be a Study of a Metallurgical process.

2. Seminar:

Each Student will select a topic related to his Project work and collect detailed information on it. The student will deliver a seminar and submit a report.

SEMESTER – 6

DM – 601: WELDING TECHNOLOGY

1. Welding Metallurgy:

Introduction, Principle and classification of welding methods. Weldability, feasibility, effect of heat on metals, identification of iron and metals, properties of metals.

3. Welding Processes and Equipments:

Gas Welding process, machines and accessories. Electric arc welding process, machines and accessories. TIG welding, process, machines and accessories. MIG welding process, machines and accessories. Submerged arc welding (automatic and semi automatic machines and accessories).

4. Special Welding Methods :

Electro slag welding,

Laser beam welding,

Plasma arc welding,

Electron beam welding,

Ultrasonic welding,

Thermit welding,

Explosive welding,

(Only principles and application to be covered).

5. Brazing And Soldering:

Physical aspects of the processes, joint preparation, alloy used and fluxes, purpose of flux, methods used for brazing and soldering, Application for various metals and alloys.

6. Effect of Weld Defects on Weld Performances:

Weld imperfections like incomplete penetration, lack of fusion under cutting etc. Why welds crack and how to prevent it? Pre- heating and post heating of welded joints. Fracture of steel weld- ments. Embrittlement of steel weldments. Inspection of welded parts.

7. Welding Of Important Metals And Alloys:
Aluminium and its alloys , Steel , cast iron

8. Welding Codes and Specification:
Welding Symbols., IS and AWS Standard, Welding codes, Specifications, Safety rules and regulations.

DM – 601P: WELDING TECHNOLOGY LAB

Laboratory Work:

1. Study of Gas welding flame and gas welding methods.
2. Practical on Electric arc welding.
3. Practical on Spot welding.
4. Practical on Seam welding.
5. Practical on TIG, MIG and SAW welding.
6. Study of furnaces for stress relieving, annealing, normalizing, preheating and post heating.
7. Study of Microstructure of weldment.

References :

1. Welding Engineering by Agarwal and Manghnani.
2. Welding and Welding Technology by L. Little.
3. Welding and Fabrication Technology by W. Kenyon.
4. Welders guide and hand book by James E. Brumbaugh.
5. AWS Welding Handbook.
6. ASM Metals Hand book Vol. 6.

DM – 602: APPLIED MATERIALS SCIENCE

1 Dielectrics:

Polarization mechanism & Dielectric Constant, Behavior of polarization under impulse and frequency switching, Dielectric loss, Spontaneous polarization, Piezoelectric effect; Applications of Dielectric Materials.

2 Polymers:

Various types of Polymers and their applications; Mechanical behaviour of Polymers, synthesis of polymers. Conducting polymers

3 Ceramics:

Structure, Types, Properties and Applications of Ceramics; Mechanical 2behaviour and Processing of Ceramics

4 Magnetism:

Concept of magnetism, Classification, dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Their properties and Applications; Hysteresis; Applications.

5 Superconductivity:

Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; High temperature Superconductors and their Applications.

6 Optical fibres:

Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode.

7 New Engineering Materials:

Metallic Glasses, Shape Memory Alloys, Memory Effect, Nano-materials- significance of 2anoscale, 0-Dimensional, 1- Dimensional, 2- Dimensional, 3- Dimensional nanostructures, Applications.

DM – 602P: APPLIED MATERIALS SCIENCE LAB

Laboratory Work:

1. Study of crystal structure
2. Dielectric constant measurement
3. Magnetoresistance measurement
4. P-n junction characteristics
5. Study of Hall Effect
6. Study of Microstructure.
7. Grain size determination

References:

1. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)

2. William D. Callister and David G. Rethwisch, Materials science and engineering: an introduction, John Wiley & Sons, 8th edition (2010).

3. M.A. Wahab, Solid State Physics:Structure and Properties of Materials, Narosa, 3rd edition, (2015).

4. Charles Kittel, Introduction to Solid State Physics. John Wiley & Sons, 8th edition 2005.

5. S. Sharma and J. Sharma, Engineering Physics, Pearson India (2018).

DM – 603: FUEL FURNACE AND REFRACTORIES

1 Introduction to Fuel

Fuel definition, Types of fuel with example (like solid, liquid, gas), Sources of different types of fuels, Merits and demerits of each fuel, Comparison of solid, liquid and gaseous fuel, relevant fuel for the given furnace.

2. Solid, Liquid Gaseous fuel

Differentiate coal used in various applications, Explain the importance of calorific value, Select the coal for furnace under consideration, Formation of coal, Types of coal, Carbonization of coal, Proximate and ultimate analysis of coal, Describe testing methods of coal, Describe the distillation of crude oil, Select the relevant liquid and gaseous fuel for the given application, Methods for testing properties like calorific value, Flash point, Fire point, Production, composition and uses of water gas and producer gas, Composition and uses of blast furnace gas and coke oven gas, Fractional distillation of crude oil.

3. Metallurgical Furnaces

Explain furnace construction and working, Explain various furnace atmosphere, Explain the working of production furnaces, Define furnaces, Classify furnaces on the basis of uses, process, fuel, Production furnaces like Blast furnaces, reverberatory, open hearth, LD, Kaldo, Explain the working of melting furnaces, Explain the working of heat treatment furnaces, Compare the environmental impact of all these types of furnaces, Melting furnaces like Cupola, Rotary furnaces, Crucible furnaces, Electric furnaces, Heat treatment furnaces like muffel and salt bath furnace, Atmospheric control in various furnaces.

4. Introduction to Refractories

Describe manufacturing of different types of refractories, List the various types of tests, State the different types of testing procedure of refractory materials, Select the relevant refractory material for the given furnace, Properties of refractory material, Manufacturing of acid, basic and neutral refractories, Test refractories like visual inspection, Pyrometric cone equivalent (PCE) test, RUL test, Spaling test, thermal conductivity test etc.

5. Advances in Furnaces

State the advances in melting furnaces, State the advances in heat, Advances in melting furnaces, Advance in heat treatment furnaces,

References:

1 Fuels, Furnace and Refractories O. P. Gupta Khanna publication, New Delhi, 6 th edition,

2 Industrial furnaces W. Trinks Wiley, New York, 5th edition, 1967

3 Refractories F.H.Norton McGraw-Hill, New York, 4th edition, 1968

4 Introduction to Foundry Tech A.K.Winter Ekay Winter. McGraw-Hill, New York,1958

HS – 604: ENTREPRENEURSHIP DEVELOPMENT & INDUSTRIAL ORAGANISATION / MANAGEMENT

1. Entrepreneur:

Concept, characteristics of entrepreneur, functions of entrepreneur, types of entrepreneur, problems faced by women entrepreneur.

2. Entrepreneurship:

Concept, growth of entrepreneurship in India, factors affecting entrepreneurial growth.

3. Project Identification, Selection And Formulation:

Meaning of project, project identification and election. Meaning of project report, significance of project report, contents and formulation of project report.

4. Financing of Enterprise:

Need for financial planning, sources of finance-term- loans, short term and long-term finance.

5. Forms of Ownership and Organizational Structures:

Meaning, types of ownership: Individual, partnership, Joint stock company, Co-operatives, public sector, Government undertakes, advantages and disadvantages of each type. Concept of organization, types: line ,functional, line-staff organization, advantages and disadvantages of each type.

6. Functions of Management:

Forecasting, order writing, product design, process planning, routines, scheduling, loading, dispatch, Control- progress reporting, expediting.

Replanning, Organizing, communicating, co-ordinating, controlling, motivating, decision-making.

7. Industrial Acts

Necessity of acts, Brief knowledge of :

(a) Factories Act 1948. (b) Industrial Disputes Act.

(c) Workmen Compensation Act. (d) ESI Act.

The information about the acts with reference to scope of Act, Provisions of the act, applicability of the act.

8. Financial Management: -

Basic economic concepts in production and product costing. Break-even Analyses. Depreciation definition, scope, causes, methods of calculating depreciation, obsolescence. Standardization advantages & disadvantages. Wages & incentives.

9. Personal Management: -

Definition & concept, Aims & objectives & functions of personal management.

Recruitment, Education & racing, Employee relations, Motivation, supervision, styles of supervision, Industrial hygiene, welfare, and safety of workers, Human needs, Industrial relations.

10. Marketing Management: -

Definition of Marketing, Market, Marketing strategies, Factors affecting marketing environment, consumer behaviour, market research, market survey, sales forecasting, sales promotion, advertising, media selection.

DM – 605: PROFESSIONAL PRACTICE – II

The proposed activities under this course are as follows.

1. Collection of information from various sources and to present it in an effective way.
2. Some modular projects related to theory contents of entire programme.
3. Market survey activities for collection, interpretation, analysis and presentation of data.
4. Event management skills and practices.
5. Mini projects on the topic of Environment Degradation and Sustainable Development.
6. Social responsibility/community services and its importance.
7. Entrepreneurial Traits development.
8. Ethics related to society (public), client, employer, colleague, self, management, judgement and his related profession.

DM – 606: MAJOR PROJECT

The Project work will be done by a group of max. 4 Students. The Students will Select a topic related to any course in their curriculum and will design and construct the required models, charts, and equipments to carry out test and trials. They will Submit a report of the work done by them in a suitable form. The project may consist of a market Survey or a literature Survey of recent developments in the field of Metallurgy or it may be a Study of a Metallurgical process.