SYLLABI OF 3RD SEMESTER (DD COURSE) FOR ALL DEPARTMENTS

INTRODUCTION TO MANAGEMENT & INDUSTRIAL SOCIOLOGY (HU-3401)
(COMMON TO ALL DISCIPLINES)

Weekly Contact: 4-0-0 Full Marks: 100 (Credit: 4)

Sl. No.	Module Name and Topics	No. of Lectures
1.	Introduction to Management; Process, Policy Rules, Procedures	02
2.	Three levels of Management - Corporate, Business and Functional; Strategies of Corporate level	04
3.	Expansion, Stability, Retrenchment and Combination Strategies	04
4.	Functional areas of management and assessment of functional capabilities viz. Marketing, Operations, Logistics, HRM, Materials Management, R&D, General staff functions.	06
5.	Analysing the performance through a structured model: Value Chain Analysis	02
6.	Services Marketing; Export Marketing & Industrial Marketing & Case Studies for internal assessment	06
7.	Industry- its nature, evolution and scope	02
8.	Impact of social structure on industry. Industrialization and social change. Industry in the age of information. Towards a Sociology of Industry	04
9.	Organization – types, features and theories. Importance of understanding organizational behaviour.Motivation – Definition and theories. Motivation differentials	06
10.	Work – definition, characteristics. Theories of work. Changing nature of work in a global economy. Gendered nature of work	04
11.	Global Market – its genesis, necessity and nature. Knowledge economy – its meaning, scope and approaches. Intellectual property rights and industry	04
12.	Environment and industry – global issues and local manifestations.New managerialism – the role of industrial ethics and values.	04
	TOTAL:	48

Suggested Readings for Introduction to Management:

1. Marketing Management by Philip Kotler. PHI,New Delhi. Latest edition.
2. Essentials of Strategic Management byHunger &Wheelen. PHI, New Delhi,4th edition.
3. Golding, E.W., “Electrical Measurement and Measuring Instruments”, 3rd Edition, Sir Issac Pitman and Sons.
4. Buckingham, H. and Price, E.N., “Principles of Electrical Measurements”.

Suggested Readings for Industrial Sociology

1. Sociology of Work by Keith Grant and Darren Nixon. Polity. 2015
2. Organization, Class and Control by S. Clegg and D. Dunkerley. Routledge 2013
3. Science Industry and Society by S. Cotgrove and S. Box. Routledge. 2008
4. Sociology, Work, and Industry.Watson Tony J. Routledge Kegan Paul, 1995.

5. Industry and Labour. E. A. Ramaswamy Oxford University Press. New Delhi, 1998.

Subject : Mathematics-III (MA-301)
(Common to all Disciplines)

Weekly contact periods: 3– 1 - 0 (L – T - S) Full Marks: 100 (Credit: 4)
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Sl. No	Module Name and Topics	No. of Lecture Classes
1.	**Probability :** Intuitive Notion, Classical definition of probability, Combinatorial applications, Axiomatic approach to probability theory, Univariate probability distributions – discrete and continuous. Standard distributions : Binomial, Poisson, Geometric, Hypergeometric, Exponential, Normal, Uniform and Gamma. Bivariate distributions : concepts of joint and conditional distributions, Mathematical expectation, variance and covariance, Correlation coefficient, Tchebycheff'sinequality. Concept of convergence in probability. Laws of Large Numbers (Statement only). Sample Distributions : χ^2, t and F	14
2.	**Statistics :** Concept of Statistics,Elements of the theory of PointEstimation: Unbiasedness and Mean Squared Error-Bias-variance decomposition. Minimum Variance Unbiased Estimators. Maximum Likelihood Estimation. Consistent Estimators. Interval Estimation:Confidence interval for mean of a normal population. Correlation and Regression. Simple linear regression model.	9
3.	**Laplace Transform:** Definition**,** Laplace transform of elementary functions, basic operational properties, Inverse Laplace transform, Convolution Theorem,Applications to initial value problems involving Ordinary Differential Equations.	6
4.	**Linear Programming Problem :** Basic solution, reduction of basic solution to basic feasible solution, convex combination, convex set, extreme points, hyperplanes, slack and surplus variables, Simplex Method, Charnes' Big-M method , Two Phase method.	10
	Total:	**39**

Aerospace Engineering (3rd Semester)

FLUID DYNAMICS (AE 301)

Contact Period:3L + 1T **Full Marks:**100 **[Credit – 4]**

Prerequisites: Engineering Mechanics, Mathematics (ODE, PDE, Vector Calculus)

Sl No.	Article	No. of Classes
1	**Introductory concepts:** Continuum; Eulerian and Lagrangian description of motion; Fluid properties (viscosity, compressibility, speed of sound);Dimensions and Units; Flow visualization; Classification of fluid flow; Equation for hydrostatic pressure variation, manometers, pressure variation in atmosphere; Fluids in rigid body motion - uniform linear acceleration and rigid body rotation	9
2	**Control volume analysis:** Integral and differential analysis of fluid flow, Reynolds transport theorem, Conservation equations for mass, linear momentum, angular momentum& energy, and their **applications;** continuity and momentum Eq.s in unidirectional flow; Idealized theory of propeller and windmill; Control volume analysis in non-inertial frame (accelerating control volume e.g. rocket, etc.)	10
3	**Elementary fluid dynamics (Incompressible flow):** Equation of motion along a streamline (Euler's Eq.) and normal to a streamline, Bernoulli's equation and its applications;Laminar and turbulent flow through pipes, Darcy's equation for fully developed flow, Hagen-Poiseuille equation and Moody diagram, critical Reynolds number, major and minor head loss; kinetic energy correction factor and momentum correction factor; Flow measurements (Pitot tube, orificemeter, venturimeter, etc.)	10
4	**Introduction to differential analysis of fluid flow:** 3D continuity equation in Cartesian and cylindrical reference frame, Stream function; Kinematics - translation, rotation and deformation of a fluid element (in 2D), Vorticity and Circulation;3D equation of motion (Euler's equation) from a control volume approach	6
5	**Ideal flow:** Irrotational flow and velocity potential, Vortex motion, Elementarypotential flow patterns – source, sink, uniform stream; Axisymmetric potential flow andprinciple of superposition;Equation of motion for potential flow, Unsteady Bernoulli's equation and its application	9
6	**Dimensional Analysis and similarity:** Buckingham's Pi theorem; Geometric, Kinematic and Dynamic similarity, Dimensionless parameters	4
	Total	**48**

Books:

R W Fox and A T McDonald, *Introduction to Fluid Mechanics*, Wiley India

F M White, *Fluid Mechanics*, McGraw-Hill International

Rigid Body Dynamics (AM 302)
(Common Course for AE & ME)

Contact Period : 3L + 1T per week **Full Marks : 100 [Credit – 04]**
Prerequisite : Engineering Mechanics

Sl No.	Article	No. of Classes
1	**Introduction** : Kinematics and dynamics, frames of reference, coordinate systems, particle and rigid bodies, scalars, vectors and tensors	01
4	**Kinetics of systems of particles and variables mass problems**	10
5	**Kinetics of particles in accelerating frame of reference** : • Frames with Linear Acceleration, D'Alembert's Principle • Motion in Rotating Frame of Reference	10
6	**Dynamics of rigid bodies in plane motion** : • Definition of Rigid Bodies and Kinematic constraints • Kinematics of Rigid Bodies – Translational Motion, Pure Rotation and General Motion • Linear and Angular Momentum, Kinetic energy • FBD and Laws of Motion • Conservation Principles – linear and angular Momentum, Energy • Impulsive Forces and Moments	10
7	**Dynamics of Motion in Three-dimension** : • Chasle's Theorem and Spheric Motion • Angular Momentum and Inertia Tensor, Kinetic Energy • Free Motion of an Axisymmetric Body – Body cone and Space cone • Euler's Equation, Modified Euler's Equation, Euler Angles, Gyroscopic Acion.	10
	Total	**41**

Text Book : 1. Engineering Mechanics : Dynamics – Meriam & Kraige

Strength of Materials (AM304)
(Common Course for AE & ME)

Contact Period:3L + 1T **Full Marks:**100 **[Credit –** 4**]**

Sl No.	Article	No. of Classes
1	Stress, Strain, stress at a point, stress-strain diagrams of ductile and brittle materials, Hooke's Law, Factor of Safety	03
2	Elastic constants, Poisson's ratio, pure shear, shear modulus, bulk modulus, relation among the Elastic constants	04
3	Problems related to stress and strains, thermal stress problems	04
4	Bi-axial stress, principal stress and strain, thin-walled pressure vessels, rings subjected to internal pressure	04
5	Shear force and bending moment diagrams, bending of beams due to transverse load, Euler-Bernoulli's Equation, section modulus, simple bending formula, applications	06
6	Shear stresses in beams, built-up sections, stiffened sections	05
7	Complex stress and strain, Mohr's circle	05
8	Torsion of circular shaft & applications	03
9	Combined bending, torsion and axial thrust & applications	03
10	Deflection of beams subjected to transverse forces – integration method, area-moment theorems	05
11	Energy method – Castigliano's theorem	03
12	Elastic theories of failure & applications	03
	Total	**4848**

Text Book : 1. Elements of Strength of Materials - S.P. Timoshenko and D.H. Young.

Reference Books :

1. Mechanics of Materials – E. Popov
2. A Text Book of Strength of Materials – R.K. Bansal
3. Strength of Materials – F.P. Beer and E.R. Johnston Jr.
2. Strength of Materials (Vol. 1) – D.S. Prakash Rao

FLUIDMECHANICS LABORATORY (AM 353)
(Only for AE)

Contact Period : 3 S **Full Marks : 50 [Credit – 02]**

Sl No.	Name of experiments	No. of Classes
1	Friction losses in commercial pipes	03
2	Verification of Bernoulli's theorem	03
3	Reynolds experiment	03
4	Determination of orifice coefficients	03
5	Calibration of an orifice meter	03
6	Force of impact of jet on vanes	03
7	Performance study of a centrifugal pump at constant speed	03
8	Calibration of speed indicator of Wind Tunnel	03
9	Measurement of surface pressure distribution around a circular cylinder in two-dimensional flow	03
	Viva voce	03
	Total	**30**

STRENGTH OF MATERIALS LABORATORY (AM 354)
(Common for AE& ME)

Contact Period : 3 S **Full Marks : 50 [Credit – 02]**

Sl No.	Name of experiments	No. of Classes
1	Rockwell Hardness Test	03
2	Brinell Hardness Test	03
3	Tension Test of Metals	03
4	Experiment on Strain Hardening of Metals	03
5	Torsion Test of Circular Shaft	03
6	Experiment on Impact Test	03
7	Buckling or Critical Load for Long Column	03
8	Fatigue Testing of metals (Lecture & Demonstration)	03
9	Measurement of Beam Deflection Using Dial Gauge	03
Viva voce		03
Total		**30**

Machine Drawing (AM 351)
(Common course for 3rd Sem AE &ME)

Full paper: 0 – 0 – 3 (L – T – P); Credit: 2; Prerequisite: Drawing Practice;
Full Marks: 100

Sl.	Article	No. of Classes
1.	Development of surfaces	06
2.	Riveting, Nuts & Bolts	06
3.	Interpenetration of solids	06
4.	Section of Machine Parts	03
5.	Component drawing and assembly drawing of Machines	12
6	Evaluation	03
Total		**36**

Suggested readings:
1. Engineering Drawing – N.D. Bhatt
2. Engineering Graphics – Venugopal
3. Machine Drawing – N.D. Bhatt

HYDRAULICS (AM 303/1) (Only for Civil Engg)

Contact Period : 3L + 1T **Full Marks : 100 [Credit – 04]**

Sl No.	Article	No. of Classes
1	**Dimensions and SI units of physical quantities relevant to fluid mechanics.** **Fluid pressure** : absolute and gauge pressures, measurement of pressure by piezometer, different types of manometers and pressure gauges. Hydrostatic pressure forces on flat and curved surfaces, concept of pressure prism. Centre of pressure.	05
2	**Fluid kinematics & basic equations of fluid flow:** steady flow, uniform flow, laminar flow, turbulent flow, streamline, stream tube, streak line, path line, concept of one/two/three dimensional analysis of flow. Continuity equation for unidirectional flow, local & convective accelerations, Euler's equation of motion along a streamline, Bernoulli's energy equation, momentum equation, KE correction factor and momentum correction factor.	06
3	**Flow measurements**: flow through orifices, orifice coefficients, mouthpieces attached to orifices, velocity measurement by Pitot tube, measurement of discharge by venturimeter, orificemeter, notches & weirs of different shapes and corresponding formulae.	06
4	**Basic hydrodynamics** [ideal fluid flow]: three-dimensional continuity equation, rotational & irrotational flows, velocity potential function & stream function, equipotential line & stream line, flow net, circulation & vorticity.	04
5	**Dimensional analysis**: dimensional homogeneity of an equation, Buckingham π theorem and their application to fluid flow problems. Geometric, kinematic and dynamic similitude. Reynolds law & Froude's law, corresponding dimensionless parameters applicable to various flow situations.	05
6	**Viscous flow through pipes**: derivation of Navier-Stokes equations and its application to viscous flow through circular pipes, Hagen-Poiseuille velocity distribution, average velocity, discharge, pressure drop, wall shear stress and friction factor. Critical Reynold's number.	08
7	**Turbulent flow through pipes**: concept of turbulence, effects of turbulence on velocity distribution, Prandtl mixing length and universal velocity distribution. Hydraulically smooth & rough pipes. Average velocities derived from velocity distributions. Friction factors given by Karman-Prandtl equation and Colebrook & White equation. Derivation of Darcy-Weisbach equation for major head loss, friction factor & Moody diagram, different types of minor losses, hydraulic & energy grade lines, flow through pipes connected in series and/or parallel. Transmission of hydraulic power through pipes and pipe economics. Analysis of pipe network. Three reservoir problems.	14
	Total	**48**

Books:

R W Fox and A T McDonald, *Introduction to Fluid Mechanics*, Wiley India

F M White, *Fluid Mechanics*, McGraw-Hill International

Solid Mechanics (AM 304/1)
Civil Engg 3rd Semester

Contact Period: 3L + 1T per week **Full Marks: 100 [Credit – 04]**

Sl No.	Article	No. of Classes
1	Introduction and concept of elastic behaviour, Concept of stress and strain : normal stress, shear stress, state of stress at a point, normal strain, shear strain, Hooke's law, Poisson's ratio, analysis of axially loaded members	08
2	Flexural loading: shear and moment in beams, load-shear-moment relationship, shear and moment diagrams	08
3	Flexure and shear stress in beam	04
4	Torsion: Torsion of cylindrical bars, torsional stress, modulus of rigidity and deformation	03
5	Transformation of stress and strain, principal stresses, principal strains, Mohr's circle for stress and strain, introduction to theories of failure	10
5	Combined loading: axial and torsional; axial and bending; axial, torsional and bending.	05
6	Bending of non-symmetric sections, curved beams, thin-walled pressure vessels	06
7	Strain energy due to axial forces, bending and torsion, Castigliano's theorem and simple applications	04
	Total	**48**

Text Book: 1. Elements of Strength of Materials - S.P. Timoshenko and D.H. Young.

Reference Books:

1. Mechanics of Materials – E. Popov
4. A Text Book of Strength of Materials – R.K. Bansal
5. Strength of Materials – F.P. Beer and E.R. Johnston Jr.
3. Strength of Materials (Vol. 1) – D.S. Prakash Rao

Hydraulics Lab (AM353/1)
(Only for CE)

Contact Period : 3 S **Full Marks : 50 [Credit – 02]**

	4th Semester – CE [AM 452]	No of Classes
1	Friction losses in pipe and pipe fittings	3
2	Verification of Bernoulli's theorem	3
3	Determination of orifice coefficients	3
4	Reynolds experiment	3
5	Velocity measurement using pitot static tube	3
6	Determination of metacentric height	3
7	Force of impact of jet on vanes	3
8	Determination of Manning's roughness coefficient	3
9	Friction losses in commercial pipes	3
10	Calibration of a rectangular weir	3
11	Calibration of an orifice meter	3
	Viva Voce	3
	Total	**36**

SOLID MECHANICS LABORATORY (AM 354/1)
(Only for CE)

Contact Period : 3 S **Full Marks : 50 [Credit – 02]**

Sl No.	Name of experiments	No. of Classes
1	Rockwell Hardness Test	03
2	Brinell Hardness Test	03
3	Tension Test of Metals	03
4	Experiment on Strain Hardening of Metals	03
5	Torsion Test of Circular Shaft	03
6	Experiment on Impact Test	03
7	Buckling or Critical Load for Long Column	03
8	Testing of wood	03
9	Measurement of Beam Deflection Using Dial Gauge	03
Viva voce		03
Total		**30**

Strength of Materials and Theory of Machines (AM304/2)
(For EE)

Contact Period : 3L + 1T **Full Marks : 100 [Credit – 04]**

Prerequisite : Mathematics, Engineering Mechanics (Static & Dynamics)

Sl No.	Article	No. of Classes
1	Introduction**.**	01
2	Elasticity, Stress, Strain, Hooke's Law, Poisson's Ratio, Stress-Strain Diagram, Working Stress, Proof Stress	03
3	Statically Indeterminate problems in Axial Tension and Compression, thermal Stress, Relation Between Elastic Constants	04
4	Bi-axial Stresses, Mohr's Circle for Stress	03
5	Torsion for Circular Shafts and Power Transmission	04
6	General Cases of Plane Stress, Strain Rosette	03
7	Bending Moment and Shear Force on Transversely Loaded Beams	04
8	Stresses due to Bending and Shear in Beams	03
9	Flywheel - Turning Moment Diagram, Fluctuation of Energy, Punch Press	04
10	Balancing - Dynamics of Rotating Masses, Balancing Technique, Balancing Machine	04
11	Governor – Dynamics, Speed Control, Types, Performance Parameter	04
12	Vibration - Vibration of Mechanical Systems, Free Vibration, Viscous Damping, Critical Speed, Forced Vibration, Frequency Response, Phase Lag	07
13	Dynamics of Rotating Shaft – Effect of Unbalanced Disc, Friction, Gyroscopic Effect, Bearing Stiffness	04
	Total	**48**

Books

- Timoshenko & Young - Strength of Material
- Beer and Johnston (Jr) - Mechanics of Materials
- A Ghosh and A K Mallik - Theory of Mechanism & Machines
- Robert L. Norton - Design of Machinery
- Shigley - Theory of Mechanism & Machines
- S S Rattan – Theory of Machines
- W. T. Thompson - Vibration Theory with Applications

3rd SEMESTER CIVIL ENGINEERING

Syllabus for Surveying (CE 301) 3 – 1 – 0 Credit: 4

Sl. No.	Topic	No. of hours / lectures
1	Basic concepts of surveying: Principles – Basic measurements – Control networks – Locating position - Errors in measurement – Combination of errors.	4
2	Distance measurement: Principles and methods – Errors in taping and chaining–Electromagnetic Distance measurement (EDM)– measuring principles – errors, checking and calibration.	6
3	Angle measurement: Measurement with compass and theodolite – methods of measurements – instrument adjustment – sources of error.	6
4	Levelling: Principles of levelling – equipment – effect of curvature and refraction – distribution of closing errors – reciprocal levelling, precise levelingetcTacheometry- fixed hair and tangential method.	8
5	Conventional surveys: traversing – plane rectangular coordinates – development of triangulation network – method of triangulation.	6
6	Geodetic and Satellite positioning: reference ellipsoid – geodetic coordinate system – local systems – datum transformations – orthomorphic projection – typical computation on ellipsoid – universal transverse Mercator projection – concept of GPS – principle of satellite positioning – GPS observing methods – planning of GPS survey.	10
7	Engineering survey: computation of area and volume – trapezoidal rule, simpson's rule etc. – concept of horizontal and vertical curve – practical applications– setting out of circular and transition curve.	8
	Total	**48**

Text / Reference Books

1) Surveying (Vol. 1 & 2) :Kanetkar and Kulkarni 2) Surveying (Vol. 1& 2) : S. K. Duggal
3) Surveying and Leveling : R. Subramanian 4) A Textbook of Surveying : S. K. Roy

Project on Building Planning CE-351 0-0-3 Credit:2

Sl. No.	Topic	No. of hours / lectures
1	Drawing of plan, elevation and sectional views of simple four storied building	6
2	Different Components of a Typical Building	3
3	Principles of building planning	3
4	Preparation of plan of an typical apartment building keeping in view the provisions regarding Area Height Limitations, Covered Area, Plinth Area, Ground Coverage, Open Spaces and Parking Space as per regulation of any Municipal Corporation	6
5	Drawings of plan, elevation and sectional views of the above building as per the regulation of the Municipal Corporation	9
6	Drawing of water supply sanitary system and other services of the above building	6
10	Viva / Presentation	3
	Total	**36**

Introduction to Civil Engineering Profession CE-352 0-0-3 Credit:2

Sl. No.	Topic	No. of hours / lectures
1	Department of Civil Engineering-an overview, curriculum, and	3

	policies	
2	Brief history of Civil Engineering Professionand Opportunities	3
3	Role of Civil Engineering Technology in Society, Various Professional Societies in the Civil Engineering field, Code of Ethics,	3
4	Overview of Civil Engineering:Structural Engineering,	3
5	Overview of Civil Engineering:Geotechnical Engineering,	3
6	Overview of Civil Engineering:Transportation Engineering,	3
7	Overview of Civil Engineering:Environmental Engineering	3
8	Overview of Civil Engineering:Water Resources Engineering,	3
9	Overview of Civil Engineering: Materials and Construction	3
10	Civil Engineering Quiz/Presentation etc. by students	6
	Total	**36**

Third Semester (Computer Science and Technology)

Digital Logic (CS 301)

Weekly Contact: 3-0-0 **Full Marks: 100(Credit: 3)**

Module	Module name and topics	Hours

1	**Number Systems and Binary representations:** 1's complement, 2's complement, gray codes, excess-3, BCD, etc	4
2	**Boolean Algebra and Logic gates:** Truth table, Postulates and axioms, SOP and POS forms, Minimization with K-map and Quine McCluskey method, NAND/NOR realization	6
3	**Combinational circuits:** Design of Adder, Parity Generator, Code Converters. Multiplexers, Demultiplexers, Encoders and Decoders, Realization of logic functions	6
4	**Sequential Circuits:** Latch, Flip-flop. Counters, Registers. Design and analysis of sequential circuits - Moore and Mealy model description, state diagram and state table – Minimization methods. Memory unit. Racing and logic hazards, hazard free logic circuit design	10
5	**Digital Integrated Circuits:** Diode as switch. AND/OR realization with diodes. Transistor as a switch. RTL, DTL, TTL logic gate circuits. MOS as a switch. Basic MOS inverter. MOS and CMOS logic gates. Fan-in and Fan-out of logic gates, propagation delay, Tristate logic	10
	Total	36

Data Structures and Algorithms (CS302)

Weekly Contact: 3-0-0 **Full Marks: 100**
(Credit: 3)

Module	Module name and topics	Hours
1	**Abstract Data Type (ADT) and Algorithm:** ADT - concepts, data structure and ADT, properties applicable for ADT. Algorithm - properties, concepts of time and space complexity	3

2	**Linked Lists:** Linear linked list, circular linked list, doubly linked list, Multi-list, applications	5
3	**Stacks and Queues and Trees:** Stacks and queues - Concepts and applications. Trees - Binary trees. Properties, Binary tree traversals, Expression trees, Conversion from general tree to binary tree. Binary Search Trees and operations on BST, Height balanced tree – AVL tree	10
4	**Heap:** Heap data structure and priority Queues	2
5	**Graph:** Representations of Graph, Graph traverssal and its applications	4
6	**Recursion:** Recursion and Iteration, Design of recursive algorithms	4
7	**Sorting and Searching:** Insertion sorts, Exchange sorts, Selection sort, Merge sort, Distribution sort. Comparisons of different sorting algorithms. Sequential search, Binary search, Interpolation search and comparisons	8
	Total	36

Discrete Structures (CS 303)

Weekly Contact: 3-1-0 **Full Marks: 100 (Credit: 4)**

Module	Module name and topics	Hours
1	**Sets, Relations and Functions:** Combinations of sets, finite and infinite sets, countable and uncountable sets, multi-sets. Dataset modeling using relation, binary relations, compositions,	5

	equivalence relation and partitions, Partial ordering relations and lattices, chains and anti-chains etc	
2	**Discrete Numeric Functions and Generating Functions:** Numeric functions and their asymptotic behavior, Generating functions and their use for solving combinatorial problems.	3
3	**Recurrence Relations and Recursive Algorithms:** Linear recurrence relations with constant coefficients, homogeneous, partial and total solutions. Solution using generating functions	3
4	**Boolean Algebras:** Lattices and Algebraic systems, Distributed and complemented lattices, Boolean lattices and Boolean algebra.	4
5	**Proof Methods:** Informal proof methods; Proof by mathematical induction	3
6	**Logic:** Elementary logic; Propositional logic (PL) - Atoms, Logical operators, Compound propositions, Well-formed formula (wff) in PL and Semantics, Logical equivalences, Satisfiability and Validity, Normal forms, Logical consequence, Formal reasoning in PL. First order predicate logic (FOPL) - Predicates and quantifiers, wff and semantics in FOPL, Domains and interpretations, Validity, Equivalent formulae, Prenex normal form, Formal proofs in FOPL.	12
7	**Graph Theory:** Introductory concepts and definitions; Paths and cycles: Eulerian and Hamiltonian paths and cycles. Trees: Properties, Spanning tree, Minimum spanning tree. Planner graphs and colouring. Network flow	10
	Total	40

ELECTRICAL MACHINES (EE 304)

(for CST)

Pre-requisite: Basic Electrical Engineering (EE-1201)

Weekly Contact: 3-0-0 **Full Marks: 100 (Credits: 3)**

Sl. No.	Module Name and Topics	No. of Lectures
1.	Transformers: Three phase transformer connections and Phasor groups,	**07**

	Three phase to six phase conversions, Three phase/two phase (Scott) connection of transformer.	
2.	Braking of DC motors, Losses and efficiency. Test – Brake test, Swinbburne's test, speed control of DC motors using electronic devices.	**08**
3.	Braking of 3 phase induction motors, speed control of 3 phase induction motor – conventional & electronic.	**10**
4.	Single Phase Induction Motor: Construction, classification, Principle of operation, Characteristics.	**03**
5.	Universal motor – principle of operation & characteristics.	**02**
6.	al machines used in computer peripherals.	**06**
	TOTAL:	**36**

Suggested Readings:

1. Electrical Machinery – P.S. Bimbhra
2. Generalized Theory of Electrical Machines – P.S. Bimbhra
3. Theory and Performance of Electrical Machines – J. B. Gupta
4. Electrical Machines – D.P.Kothari and I.J. Nagrath

PRACTICAL

ELECTRICAL MACHINE LABORATORY (EE 354)

Weekly contact: 0-0-3 Full Marks: 100 (Credits: 2)

Sl No.	Title of the Experiments	No of periods
1	Three Phase Transformer Connection	3+3
2	Load Test On Dc Shunt Motor By Generator Loading Method.	3+3
3	Load Test On Dc Shunt Motor By Brake Method.	3+3
4	Starting Of Three-Phase Squirrel Cage Induction Motor.	3+3
5	No Load Characteristics Of Dc Shunt Generator.	3+3
6	Load Test Of A Single Phase Transformer.	3+3
	Total	36

Digital Logic Laboratory (CS351)

Weekly Contact: 0-0-3 **Full Marks: 100 (Credit: 2)**

Module	Ttile	Hours
1	**Logic family:** Implementation of OR and AND gates using	9

	diodes, Study on characteristics of DTL and TTL inverters using discrete components, Study on characteristics of TTL and CMOS gates.	
2	**Combinational logic circuits:** Design and implementation of combinational circuits such as, Adders, comparators, parity generator and checker. Implementation of Boolean functions using multiplexer and decoder/de- multiplexer.	12
3	**Sequential circuits:** Study of latch and flip-flops, design of counters.	15
	Total	36

Algorithm - I Laboratory (CS352)

Weekly Contact: 0-0-3 **Full Marks: 100 (Credit: 2)**

Module	Title	Hours
1	Review of Computing Practice: Assignments using recursive and non-recurssive functions on Array, etc.	3
2	Assignments based on Stack and its Applications: Parenthesis matching, Conversion of Expressions into Postfix notation and Evaluation , etc.	6
3	Assignments on search algorithms (sequential, binary and interpolation) on ordered and/or unordered data.	3
4	Assignments on sorting algorithms (recursive and non-recursive algorithms): bubble sort, insertion sort, selection sort, merge sort, quick sort, etc.	6
5	Assignments on queues (circular queue, priority queue): Implementation and applications.	3
6	Assignments on linked lists (linear, circular, doubly linked list, etc): Implementation and applications.	6
7	Assignments on tree (binary tree, binary search tree, arithmetic expression tree, AVL tree): Implementation, creation, operations, applications, etc.	6
8	Assignments on graph: Representations, Implementations and Applications	3
	Total	36

3rd SEMESTER ELECTRICAL ENGINEERING

ELECTRICAL MACHINES-I (EE-301)

Weekly Contact: 4-0-0 (L-T-S) **Pre-requisite: Basic Electrical Engineering (EE-1201)**
Full Marks: 100 **Credits: 4**

Sl. No.	Module Name and Topics	No. of Lectures
1.	**General concepts:** Concept of mmf and flux density distribution in ac machines – pulsating and rotating type. Basic of electromagnetic torque production and concept of torque angle.	**04**
2.	**DC Machines:** Principle of operation (motoring and generating actions),	**14**

	commutation process (brief description) and function of brush commutator assembly. Armature winding (idea only). Shunt, series and compound excitation. Magnetisation curve, OCC, Building up of dc shunt generator, critical field resistance and critical speed. Load characteristics of dc generators and motors.	
	Methods of speed control of dc motors. Armature reaction and its effects, interpole and compensating winding, parallel operation of dc machines, Equaliser connection.	**07**
	Losses and efficiency of dc machines, Swinburne's test, Hopkinson's test, Brake test.	**04**
3.	**Transformer:** Construction of three-phase transformers (core and shell type), Tap changing basics, Equivalent circuit (per phase basis), Phasor diagrams, Per unit system of representation, Voltage regulation for different types of load, maximum voltage regulation and its condition. Losses and efficiency- Efficiency load curve and maximum efficiency condition, All day efficiency. Tests: Polarity test, OC and SC test, Separation of losses, Sumpner test. Dry type and oil cooled type transformers. Brief aspects of natural and forced type of cooling. Transformer oil, Transformer accessories e.g. conservator, breather, Buchholz relay, bushings.	**14**
	Three phase connections (star-star, delta-star, delta-delta, star-delta, open delta, zigzag). Auto transformer: Principle of operation, Comparison with two-winding transformer. Vector groups, Parallel operation of single and three-phase transformers. Three winding transformer - Equivalent circuit, Role of tertiary winding.	**10**
	Phase conversion: 3 ph to 6 ph, 3 ph to 12 ph, 3-ph to 2-ph (Scott connection), Harmonics in transformer, Role of independent and interdependent magnetic circuit on performance and unbalanced operation of three phase transformers.	**07**
	TOTAL:	**60**

Suggested Readings:

1. Electrical Machinery - Fitzgerald, Kingsley & Kusko
2. Electrical Machinery and Transformer – Irving L. Kosow
3. Electrical Machinery – Dr. S.K. Sen
4. Electric Machinery – P.K. Mukherjee, S. Chakravorti

ELECTRICAL AND ELECTRONIC MEASUREMENTS (EE 302)

Weekly Contact: 4-0-0 (L-T-S) **Pre-requisite: Basic Electrical Engineering (EE-1201) Basic Electronics Engineering (ET-1201)**

Full Marks: 100 **Credits: 4**

Sl. No.	Module Name and Topics	No. of Lectures
1.	**Measurement Errors and Analysis**	**02**
2.	**Indicating Instruments:** Voltmeter, Ammeter, Range Extension–Shunt	**05**

	and Multipliers, Wattmeter.	
3.	**Integrating Instruments**:Energy meter	**03**
4.	**Measurement of Power:Active power: single wattmeter, two wattmeter method, balanced, unbalanced three phase system, Reactive Power: two wattmeter, single wattmeter methods.**	**07**
5.	**Other Electrical Instruments: Phase angle and power factor meter, frequency meter, synchroscope, meters for kVAh, kVARh, Maximum Demand Indicator, Trivector meter.**	**07**
6.	**Measurement of Resistance:** Low, medium, high and insulation resistances.	**02**
7.	**Inductance and Capacitancemeasurement**: AC bridges for inductance and capacitance measurement.	**04**
8.	**Magnetic Measurements: Magnetic measurement using Ballistic Galvanometer, Grassot Flux meter, BH curve of magnetic material, separation of losses.**	**02**
9.	**Instrument Transformers:** Current and Potential transformers, ratio and phase angle errors, design considerations, numerical problem.	**05**
10.	**Electronic Measurements:** Electronic voltmeter, multimeter, wattmeter & energy meter. Time, Frequency and Phase Angle meters; CRO, Storage oscilloscope, Spectrum & Wave analyzer.	**11**
	TOTAL:	**48**

Suggested Readings:

1. Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India.
2. Jones, B.E., "Instrumentation Measurement and Feedback", Tata McGraw-Hill.
3. Golding, E.W., "Electrical Measurement and Measuring Instruments", 3rd Edition, Sir Issac Pitman and Sons.
4. Buckingham, H. and Price, E.N., "Principles of Electrical Measurements".

Field and Circuit Theory (EE-303)

Weekly Contact hours: **4-0-0 (L-T-S)**

Pre-requisite: **Vector Calculus** in Mathematics, **Field theory Course** in Physics **and Basic Electrical Engineering** (EE1201).

Full Marks: 100

Credits: **4**

Sl. No.	Module Name and Topics	No. of Lecture

	FIELD THEORY	
1.	**Introduction:** Physical interpretation of gradient, divergence and curl. The Laplacian operator, vector relationship in rectangular, cylindrical and spherical polar coordinate systems.	05
2.	**Electric Field:** Potential and potential gradient, Stoke's Theorem, Green's Theorem, divergence and curl equations. Laplace and Poisson's equation, Helmholtz Theorem, Field equations in different coordinate systems, boundary conditions, Continuity equation and relaxation time, Energy stored due to accumulation of point charges	07
3.	**Magnetic Field:** Scalar and vector potentials. Divergence and curl of magnetic field. Force and Torque equations. Field equations in different coordinate systems. Boundary conditions	05
4.	**Permanent Magnets:** Use, second quadrant B-H curve, load line, concept and simple problems. **Electrodynamics :** Time varying field and Faraday's law. Displacement current, Maxwell's wave equation. Wave equations in conducting medium. Skin effect. Maxwell's Field equations vs circuit equations	06
5.	**Poynting vector and flow of power**: Relevance to Electrical Power Transmission	03
6.	**Direct implications in Electrical Engineering:** Elements of Electromagnetic fields in Electrical Machines. Force on conductors in Transformer and machines. Electric discharge, Applications in heating, welding.,**Superconductivity**: Elementary concepts, super conducting magnets, super conducting magnetic energy storage	04
	CIRCUIT THEORY	
7.	**Dependent and Independent Sources:** Review of basic Circuit Laws, Source Transformation; VCVS, VCCS, CCVS, and CCCS.	02
8.	**Network Theorems in AC circuits and for dependent sources**: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Substitution theorem, Compensation theorem, Millman's theorem andTellegen's theorem.	05
9.	**Two-port Networks:** Network elements – Concepts of ports and terminals; Classification of network, network configuration of network; *Z*-, *Y*-, *T*-, *h*- and *g*-parameters; Conditions of reciprocity and symmetry; Interrelationship of network parameters; Input and output impedances. Interconnections of 2-port networks; Short-circuit and Open-circuit impedances, image impedances, equivalent T- and π- network.	08
10	**Coupled Circuits:** Self and Mutual Inductance, Coefficient of coupling; Connections of coupled coils; Dot convention; Modeling of coupled circuits, Electrical equivalent of magnetically coupled circuits.	04
11	**Electrical Analogous circuits:** Analogous networks for Mechanical, Thermal, Hydraulic systems etc.	05
	Total:	**54**

Suggested Readings:

Field Theory:

1. David J. Griffiths – Introduction to Electrodynamics
2. Matthew N.O. Sadiku – Principles of Electromagnetics
3. Spiegel – Electromagnetics

Circuit Theory:

1. D. Roy Choudhury– Networks and Systems

2. K.M Soni – Circuits and Systems
3. Sukhija & Nagsarkar – Circuits and Networks

ELECTRICAL MACHINES (for CST)
(EE-304)

Weekly Contact: 3-0-0 (L-T-S) **Pre-requisite: Basic Electrical Engineering (EE-1201)**
Full Marks: 100 **Credits: 3**

Sl. No.	Module Name and Topics	No. of Lectures
1.	Transformers: Three phase transformer connections and Phasor groups, Three phase to six phase conversions, Three phase/two phase (Scott) connection of transformer.	**07**
2.	ines: Braking of DC motors, Losses and efficiency. Test – Brake test, Swinbburne's test, speed control of DC motors using electronic devices.	**08**
3.	Braking of 3 phase induction motors, speed control of 3 phase induction motor – conventional & electronic.	**10**
4.	Single Phase Induction Motor: Construction, classification, Principle of operation, Characteristics.	**03**
5.	Universal motor – principle of operation & characteristics.	**02**
6.	al machines used in computer peripherals.	**06**
	TOTAL:	**36**

Suggested Readings:

5. Electrical Machinery – P.S. Bimbhra
6. Generalized Theory of Electrical Machines – P.S. Bimbhra
7. Theory and Performance of Electrical Machines – J. B. Gupta
8. Electrical Machines – D.P.Kothari and I.J. Nagrath

ELECTRO-TECHNOLOGY IN MINING (EE-305)

Weekly Contact: 4-0-0 (L-T-S) **Pre-requisite: Basic Electrical Engineering (EE-1201)**
Full Marks: 100 **Credits: 4**

Sl. No.	Module Name and Topics	No. of Lectures
1.	**Electrical Power Transmission and Distribution:**Classical Electrical Power System concept - Centralized Generation, Transmission, Distribution; Radial and ring main distribution, brief overview of DC distribution systems with major stress on AC distribution systems; Overhead and underground systems. Earthing/Grounding. Power factor improvement.	**11**
2.	**Underground Cables:** Electrical cables – principles and basic ideas; concept of cable resistance, capacitance and inductance; grading of cables, calculation of size of cables; types, installation and jointing, IS specification for mining cables	**08**
3.	**Electrical Motors, Drives and Apparatus used in Mines:** Motors, ratings and their selection; starting and braking of electric motors – elementary ideas; concepts of speed control with stress on solid state drives including Ward-Leonard and ILGNER control, SCR control; Electrical signalling, pilot and control circuits, Electromagnetic and solenoid brakes, safety rules; Special requirements for mining applications like Intrinsically safe and flame-proof apparatus	**16**
4.	**Power System Protection Issues:** Switchgear devices with stress on circuit breakers, their types based on arc quenching medium, ratings and selection; concepts of relays for power system protection, current and potential transformers, surge arrestors	**11**
5.	**Electrical Layout:**Electrical layout of a typical mine, single line diagram, a typical case study	**02**
	TOTAL:	**48**

Suggested Readings:

1. Electro technology in Mining – Neuad & Marinovic
2. Electric cables Hand book – G. F. Moore
3. A course in power systems – J. B. Gupta
4. Electrical Power – Uppal
5. Fundamentals of Electrical Drives – G. K. Dubey

ELECTRICAL MACHINE LABORATORY
EE-351

Class load/week: 3 periods
Full Marks:100 Credits: 3

Sl No.	Title of the Experiments
1	(A) No Load, Short Circuit & Load Test On Single Phase Transformer. (B) Polarity Test & Connection On Three-Phase Transformer.
2	Starting & Speed Control Of Dc Shunt Motor.
3	Load Test On Dc Shunt Motor By Brake Method.
4	Load Test On Dc Shunt Motor By Generator Loading Method.
5	Characteristics Of Dc Generator.

ELECTRICAL AND ELECTRONIC MEASUREMENTS LABORATORY (EE352)

Class load/week: 3periods (Based on EE302)
Full Marks: 100 Credits: 2

Sl. No.	Name of the Experiments
1.	Calibration of single phase A.C. kWh (Energy) meter
2.	Extension of instrument ranges using C.T. and P.T.
3.	Kelvin double bridge
4.	Phase angle & frequency measurement by electronic method
5.	Study on A.C. bridges
6.	Familiarization with oscilloscope & digital multimeter

ELECTRICAL CIRCUITS LABORATORY (EE353)

Class load/week: 3periods (Based on EE303)

Full Marks: 100 **Credits: 2**

Sl. No.	Name of the Experiments
1.	Locus diagram of A.C. circuit
2.	a) Characteristics of A.C. Single phase parallel circuit b) Charging and discharging of a series RC circuit
3.	Determination of network parameters
4.	Determination of frequency response of a two port network
5.	Three phase balanced and unbalanced circuit
6.	Study on R-L-C series resonance circuit

ELECTRICAL MACHINE LABORATORY
EE-354

Class load/week: 3 periods

Full Marks:100 Credits: 3

Sl No.	Title of the Experiments
1	Three Phase Transformer Connection
2	Load Test On Dc Shunt Motor By Generator Loading Method.
3	Load Test On Dc Shunt Motor By Brake Method.
4	Starting Of Three-Phase Squirrel Cage Induction Motor.
5	No Load Characteristics Of Dc Shunt Generator.
6	Load Test Of A Single Phase Transformer.

ELECTRICAL MACHINE LABORATORY
EE-355

Class load/week: 3 periods

Full Marks:100 Credits: 3

Sl No.	Title of the Experiments

1	Three Phase Transformer Connection
2	Load Test On Dc Shunt Motor By Generator Loading Method.
3	Load Test On Dc Shunt Motor By Brake Method.
4	Starting Of Three-Phase Squirrel Cage Induction Motor.
5	No Load Characteristics Of Dc Shunt Generator.
6	Load Test Of a Single Phase Transformer.

Network Theory (ET301)

Weekly contact : 3– 1 - 0 Full Marks: 100 [Credit-4]

Sl. No.	Module Name and Topics	Class hours
1.	**Introduction:** Network, Importance **Energy source:** Source Characteristics, Transformation of Sources.	3
2.	**General Analysis Methods:** Mesh Analysis, Node Analysis, Super Mesh and Node Analyses, Source Shifting Technique.	5
3.	**Transient Response and Steady State Response:** RL, RC and RLC Series and Parallel Circuits with various kinds of Excitations using Differential Equation approach and Laplace Transform	9
4.	**Synthesis of Complex Waveform:** Pulse, Square, Triangular, Saw Tooth, Impulse; Solution of Circuit Problems with these Waveforms. Initial and Final Value Theorems.	4
5.	**Network Theorems:** Transform Impedance and Admittance, Series and Parallel combination; Thevenin, Norton, Superposition, Millmann, Reciprocity, Compensation, Maximum Power Transfer, Telegene's Theorems.	6
6.	**Network Functions:** Driving Point and Transfer Functions, One-Port Network, Two-Port Network Parameters, Parameter Conversion, Input and Output Impedances, Image Impedance, Characteristic Impedance.	9
7.	**Resonance:** Series and Parallel, Q-Factor, BW.	4
	Concept of Poles and Zeros: Restriction on Poles and Zeros in s-plane, Time-Domain Behaviour from Pole-Zero Plot.	2
8.	**Elements of Network Synthesis:** Hurwitz Polynomial, Real and Reactive Functions, Synthesis of RL, RC, LC Networks.	6
	Total	**48**

Prerequisite: Knowledge of Laplace Transforms, Differential Equation and its Solution, Matrix

Text Books/References:

1. Network analysis- Van Valkenburg
2. Networks and systems- D. Roy Choudhury
3. Network analysis & synthesis - Wadhwa
4. Circuit Theory - Iyer
5. Network analysis & synthesis- F. Kuo
6. Network synthesis- Van Valkenburg

Analog Electronics (ET302)

Weekly contact : 4– 0 - 0 Full Marks: 100 [Credit-4]

Sl. No	Module Name and topics	No. of lectures
1	Biasing schemes for BJT, CE,CB, CC configurations, bias stability, bias compensation	4
2	Low frequency BJT models, small signal analysis of transistor amplifier circuits using h parameters, design procedure of amplifiers.	4
3	High frequency BJT models: Hybrid-Pi model, high frequency response of single stage amplifiers. Millers theorem.	4
4	Field Effect Transistors: Principle of operation, biasing circuits. FET amplifiers-CS, CD, CG configuration. Low frequency models, high frequency models, analysis of single stage amplifier.	6
5	Multistage amplifiers: Cascaded stage, cascode stage, Darlington pair, Low frequency response and high frequency response of multistage amplifier	4
6	Feedback Amplifiers: Topologies- voltage series feedback, current shunt feedback, current series feedback, voltage shunt feedback, effect of feedback on gain, bandwidth., calculation with practical circuits, concept of stability, gain margin and phase margin.	4
7	Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators, LC oscillators, non-sinusoidal oscillators.	4
8	Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR, Slew rate.	4
9	Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (V_{ON}), maximum usable load.	4
10	Power Amplifiers: Class A, B, AB, and C; power efficiency and linearity.	4
11	Linear wave shaping circuits: RC filter, integrator, differentiator.	3
12	Multivibrators using BJT: Bistable, monostable and astable. VCO.	3
	Total	**48**

Prerequisites: Basic Electronics, Fundamentals of Circuit theory

Text Books/References:

1. Electronic Principles: Malvino, TMH
2. Integrated Electronics: Millman and Halkias, Mcgraw Hill
3. Microelectronics: Millman and Grabel, MGH
4. Electronic Circuits: Schilling and Belove, TMH
5. Microelectronic Circuits: Sedra and Smith, Oxford University Press

Electronic Devices (ET 303)

Weekly contact : 4– 0 - 0 Full Marks: 100 [Credit-4]

L-T-P: 4-0-0 Credit: 4 Full Marks: 100

Sl. No	**Module Name and topics**	No. of lectures
1.	Introduction	1
2.	Equilibrium carrier concentrations; Thermal Equilibrium and wave particle duality; Intrinsic semiconductor : Bond and band models; Extrinsic semiconductor: Bond and band models, calculation of carrier concentrations from allowed energy states, density of states and Fermi Dirac statistics	6
3	Carrier transport; Random motion; Drift and diffusion; mobility, velocity saturation	4
4	Excess carriers; Injection level; Lifetime; Direct and indirect semiconductors	3
5	Procedure for analyzing semiconductor devices; Basic equations and approximations	2
6	P-N Junction; Device structure and fabrication;Equilibrium picture; DC forward and reverse characteristics; Small-signal equivalent circuit; Switching characteristics ;Solar cell	6
7	Bipolar Junction Transistor: Device structure, fabrication, and its operation;Common emitter DC characteristics, Ebers Moll model.Small-signal equivalent circuit: Hybrid model,SPICE model. Early effect.Unipolar Junction Transistor.	6
8	Ohmic and Rectifying junctions; Schottky diodes, Schottky transistors.	4
9	Junction Field Effect Transistor: Device structure and operation, common source DC characteristics. Metal Oxide Semiconductor(MOS) capacitance: C-V characteristics, threshold voltage, body effect. MOSFET:Device structure and operation, common source DC characteristics. FET small-signal equivalent circuit; SPICE level-1 model; Differences between a FET and a BJT	6
10	Special purpose Devices:Tunnel diode; Gunn diode; IMPATT diode; Varactor Diode; MESFET	6
11	Recent Developments; Heterojunction FET; Heterojunction Bipolar Transistor	2
	Total	**46**

Text Books/References:

1) Physics of semiconductor devices, S. M. Sze, John Willey & Sons, N.Y.
2) Semiconductor Physics and Devices – D.A. Neaman, Tata McGraw Hill
3) Solid State Electronics Devices- Streetman, Banerjee, PHI, New Delhi.
4) Integrated Electronics – Millman & Halkias, TMH
5) Semiconductor Devices-J.Singh

Signals and Systems (ET304)

Weekly contact : 3– 1 - 0 Full Marks: 100 [Credit-4]

Sl. No	Module Name and topics	No. of lectures
1.	Signals and systems, definitions, classification and representation of signals	4
2.	Concepts of linear vector space and orthogonal signal representation	4
3	Discrete signals and systems, sampling, digitization and reconstruction of analog signals. State representation.	6
4	LTI systems: linearity, causality, stability, impulse response, convolution, transfer function. Signal distortion in transmission, conditions for distortionless transmission.	8
5	Fourier series, Fourier transform and its properties	6
6	Random variables, random vectors, and random processes, classification, characterization.	6
7	Random signals and their properties, auto and cross-correlation, power spectral density. Thermal and shot noise.	6
8	System response to random signals, functions of random signals	**4**
9	Hilbert transform and its properties.	**2**
	Total	**46**

Text Books/References:

1) Signals & Systems- Oppenheim, Willisky &Nawab
2) Principles of Linear Systems and Signals-B.P.Lathi
3) Signals & Systems- S. Haykin
4) Modern digital and analog communication systems- B. P. Lathi

PRACTICAL

Network Theory Lab (ET351)

Weekly contact : 0-0-3 **Full Marks: 50 [Credit-2]**

Sl. No.	Name of Experiment	Class hours
1.	Verification of Thevenin's & Norton's theorems	3
2.	Study on Maximum power transfer theorem	3
3.	Study of two-port network parameters.	3
4.	Investigation on a series resonant L-C-R circuit.	3
5.	Investigation on a parallel resonant L-C-R circuit.	3
6.	Study on transient response of series R-L, R-C, R-L-C circuits to step DC.	3
7.	Investigation on differentiator and integrator by R-L and R-C circuits.	3
8.	Study of characteristics of symmetrical and asymmetrical networks.	3
	TOTAL	**24**

Analog Electronics Lab (ET352)

Weekly contact : 0-0-3 **Full Marks: 50 [Credit-2]**

Sl. No	Name of the Experiment	class hours
1	a)Design a single stage Amplifier with different Biasing Techniques b) Measurement of Transistors Hybrid Parameters.	3
2	Analysis of Common Base and Common Collector Amplifier to Measure Different Parameters.	3
3	a) Determination of JFET Characteristics. b) Design of RC Coupled amplifier using JFET	3
4	To study the frequency Response of a Cascaded RC Coupled Amplifier.	3
5	a) To understand the basic concept of positive feedback and to verify Barkhausen criteria for starting sustaining an Oscillation. b) To Design and Construct a RC Phase Shift Oscillator	3
6	a) To understand the basic principle of current mirror and to determine its output resistance (rout) and minimum sustainable voltage (VON). b) To verify use of the cascade topology to increase the output resistance.	3
7	a) To understand the basic operation of a Differential amplifier and to determine its differential gain and common mode gain. b) To appreciate the use of a current source in order to improve the common mode rejection ratio.	3
8	To Design and Construct a Wien Bridge,/ Hartley and Colpitt Oscillator/	3
	TOTAL	24

Experiment lists may be changed based on the subject **Analog Electronics (ET302)**.

Electronic Devices Lab (ET353)

Weekly contact : 0-0-3 **Full Marks: 50 [Credit-2]**

Sl.No.	Name Of the Experiment	Class hours
1.	Measurement of Resistivity of a semiconductor and thin film material	3

	by four probe technique.	
2.	Determine the Band gap of the semiconductor specimen.	3
3.	Measurement of Hall Voltage of a semiconductor specimen by Hall probe method.	3
4.	Design and fabrication of a constant current generator compatible with four probe setup.	6
5.	Measurement of Hall parameters, sheet and bulk carrier concentration and resistivity of a specimen by Hall effect measurement	6
	TOTAL	21

Experiment lists may be changed based on the subject **Electronic Devices (ET303)**.

Information and Technology (Third Semester)

PROGRAMMING AND DATA STRUCTURES (IT301)

Prerequisite: Concepts of C Language

Weekly contact: 4 – 0 – 0 **Full Marks: 100 (Credit: 4)**

Sl. No.	Module Name and Topics	No. of Classes
1.	**Introduction**:Functions; arrays; introduction to pointers; structures; dynamic allocation; linked structures; time and space requirements.	6
2.	**Stack**: Introduction, Array Implementation Multiple Stacks, Applications and use of Stacks: Conversion from Infix to Postfix, Evaluation of Postfix Expressions, Prefix Notation, etc.	6
3.	**Queue:** Introduction, Linear Queue, Circular Queue, De-queue, Priority Queue, ArrayImplementations of Queues, Applications of Queues, General Lists.	4
4.	**Linked Lists:**Introduction, pointer and Implementation, Linear Linked Lists, Circular Linked Lists, Doubly Linked Lists, Doubly circular, Implementation of Linked Lists, Linked Stacks and Queues, Application of Linked List: Polynomials, High precision Arithmetic, Josephus Problem, etc.	8
5.	**Recursion:** Recursion Algorithm, Type of Different Recursion Algorithms, Removal of Recursion.	2
6.	**Binary Trees:** Tree Terminology, Binary Tree, Binary Tree Representation, Binary Tree Traversals, Threaded Binary Tree,Binary Search Tree Concepts and Implementation.AVL Tree.	10
7	**Search Methods:**Linear search, Binary search, Complexities of the searching algorithms.	4
8	**Sorting:** Introduction to sorting and Comparison of Sorting Techniques.	4
	Total:	**44**

Suggested Reading:

1. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill.
2. Ellis Horowitz, SatrajSahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, W. H. Freeman and Company.
3. Goodrich, Michael T. & Roberto Tamassia, Algorithm Design, Wiley Singapore.
4. Cormen, Thomash H., Leiserson, Charles E., Rivest, Ronald L., & Stein, Clifford. Introduction to Algorithms.

DIGITAL LOGIC AND CIRCUIT DESIGN (IT 302)

Weekly contact: 4 – 0 – 0 **Full Marks: 100 (Credit: 4)**

Sl. No.	Module Name and Topics	No. of Classes
1.	Number systems and Codes: Number representation and Computer arithmetic (fixed and floating point), Codes	1

2.	Boolean Algebra and Minimization Techniques:Boolean Logic operations, Basic laws, De Morgan's theorems, SOP/POS, K-map, Quine-McCluskey or Tabular method of minimization	3
3.	Logic Gates:Logic Gates (OR, AND, NOT, NAND, NOR, Universal building blocks, XOR,XNOR), Mixed Logic,Multilevel Gating networks, Multilevel output gate networks	2
4.	Logic Families: Digital Integrated Circuits, Introduction to logic families, CMOS logic	2
5.	Combinational Circuits:Multiplexers, Demultiplexers, Decoders, Application to Liquid Crystal Display (LCD), Encoders, Parity Generator/Checker, Code converters, Magnitude comparators, Applications	6
6.	Arithmetic Circuits:Half adder, Full adder, Half subtractor, Full subtractor, Parallel binary adder, Controlled Inverter, 4-bit parallel adder/subtractor, Fast adder, Serial adder, Serial subtractor using 2's complement, 4-bit serial adder/subtractor, BCD adder, Binary multiplier, Binary divider	6
7.	Flip-Flops:Latches, Flip-Flops (Clocked SR, JK, D, T), Triggering of Flip-flops, Asynchronous inputs in flip-flops, Master-slave flip-flops, Realization of one flip-flop using other, Flip-flop ICs, Applications	6
8.	Counters:Asynchronous (Ripple or Serial) counters: Ripple counter with decoded outputs, Ripple counter with modulus, Counter ICs, Asynchronous UP/DOWN counter, Propagation delay in ripple counters, Synchronous (Parallel) counter: Synchronous counter with ripple carry, Synchronous UP/DOWN counter,Applications	3
9.	Registers:Universal shift registers, Shift register counters, Sequence generator	2
10.	Memory devices:Classification, Basic memory structure, ROM, RAM, Memory decoding, Memory expansion, PLD	3
11.	D/A and A/D converters:Analog and digital data conversions, Specifications of D/A converter, Basic D/A conversion techniques (weighted resistor, R-2R ladder type etc.), MDAC, Sampling process, A/D converters, Different A/D converters (Successive approximation, Single slope, Dual slope)	4
12.	Applications of Digital Circuits:Frequency counter, Dot matrix display system, Digital multimeter etc.	2
	Total:	**40**

Suggested Reading:

Logic and Computer Design Fundamentals: by Mano, Kime: Pearson
Modern Digital Electronics: by Jain: TMH
Digital Design: by Mano
Digital Fundamentals: by Floyd, Jain: Pearson
Digital Circuits and Design: by Salivahanan, Arivazhagan: Vikas
Digital Principles and applications (5th Edition) : Leach & Malvino
Digital Computer Electronics : Malvino

DISCRETE MATHEMATICS AND GRAPH THEORY (IT 303)

Prerequisite: Preliminary concepts of Sets, Numbers

Weekly contact: 3 – 1 – 0 **Full Marks: 100 (Credit: 4)**

Sl. No.	Module Name and Topics	No. of Classes
1.	**Logic and Proofs:** Propositions, Conditional propositions and Logical Equivalence, Predicate calculus, quantifiers, Normalization of well-formed-formulas, Method of proofs, mathematical induction.	8
2.	**Language of Mathematics:** Sets, sequences and strings, Number systems, Relations, Equivalence relations, Matrices of relations, partial order sets, well order sets, quasi order sets, lattice. Application to relational Databases, Functions, Inverse and composition of functions, one-to-one correspondence.	6
3.	**Algebraic structures:** Algebraic structures with one binary operation - semigroups, monoids and groups. Free and cyclic monoids and groups, permutation groups, normal subgroups. Algebraic structures with two binary operations - rings, integral domains and fields. Boolean algebra and Boolean ring.	8
4.	**Counting methods:** Basic principles of counting (Inclusion- exclusion, addition and multiplication rules), permutations and combinations, algorithms for generating permutations and combinations, binomial coefficients and combinatorial identities, The pigeonhole principle. Introduction to Polya's theory of counting.	8
5.	**Recurrence relations:** Introduction, recursively defined sequences, solving recurrence relations: the characteristic polynomial and generating functions. Applications to analysis of algorithms.	6
6.	**Graph theory:** Introduction to graphs and their basic properties: degree, paths and cycles, subgraphs, isomorphism, Euler and Hamiltonian paths and cycles, representation of graphs, connected graphs, planar graphs. Basic graph searching algorithms: BFS and DFS. Basics of tree and spanning tree.	8
7	**Coloring of Graph:** graph coloring basics, chromatic number, 4-color problem.	4
	Total:	**48**

Suggested Reading:

1. Discrete Mathematics and its Applications by Kenneth H Rosen, PHI
2. Discrete MATHEMATICS FOR Computer Scientists, J L Mott, A Kandel, and T P Baker
3. Concrete Mathematics: A Foundation for Computer Science, by Ronald Graham, Donald Knuth, and Oren Patashnik
4. Graph Theory With Applications To Engineering And Computer Science, NarsinghDeo, Tata McGraw Hill
5. Graph Theory, F Harary, Narosa

SIGNALS, SYSTEMS AND CIRCUITS (IT 303)

Prerequisite: Vector space, probability and statistics

Weekly contact: 3 – 1 – 0 Full Marks: 100 (Credit: 4)

Sl. No.	Module Name and Topics	No. of Classes
1.	Introduction to signals: classification and representation, concepts of linear vector space and orthogonal signal representation.	4
2.	Fourier series, Fourier transform and its properties	6
3.	Parseval's theorem, Bandwidth of signals, duality of time and frequency representations of signals.	2
4.	Discrete time signal: sampling, digitization and reconstruction of analog signals.	6
5.	Introduction to random signals and their properties: random variables and processes for characterization and analysis of message signal and noise	6
6.	Random process, classification of random processes, geometric representation of random process, Gaussian random process, auto and cross-correlation, power spectral density.	10
7	Introduction to system and classification, discrete time system, signal distortion in transmission, distortionless conditions. linear time invariant (LTI) system, impulse response, convolution, transfer function, Bandwidth of systems. System response to random signals.	8
8	System realization as simple electrical circuit: Laplace transform and its properties, inverse Laplace transform, application of Laplace transform for analysis of RC, RL and RLC circuits, transient and steady state response.	6
	Total	**48**

Text Books:

1) Modern Analog and Digital Communication Systems, 4th Edition-B. P. Lathi & Z. Ding, Oxford University Press
2) S. Haykin, Communication Systems- John Wiley
3) Linear Systems and Signals, B. P. Lathi, Oxford
4) Probability and Random Processes with Applications to Signal Processing- H. Stark, J. W. Woods, Pearson Education Asia

Reference Books:

1: A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals & Systems, Pearson
2: S. Haykin & B.V.Veen, Signals and Systems- John Wiley

PRACTICAL

PROGRAMMING AND DATA STRUCTURE LABORATORY (IT 351)

Weekly contact: 0 – 0 –3 **Full Marks: 50 (Credit: 2)**

Module Number	Topics	No. of Classes
	Program related to	
1.	pointer, array, structure and union	6
2.	Stack and Queue	6
3.	Linked Lists	6
4.	Recursion and Binary Tree	12
5.	Search Methods	6
6.	Sorting	6
	Total:	42

Suggested Reading:

1. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill.
2. Ellis Horowitz, SatrajSahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, W. H. Freeman and Company.
3. Goodrich, Michael T. & Roberto Tamassia, Algorithm Design, Wiley Singapore.
4. Cormen, Thomash H., Leiserson, Charles E., Rivest, Ronald L., & Stein, Clifford. Introduction to Algorithms.

DIGITAL LOGIC AND CIRCUIT DESIGN LABORATORY (IT 352)

Prerequisite: Concepts of C Language

Weekly contact: 0 – 0 –3 **Full Marks: 50**
(Credit: 2)

Module Number	Topics	No. of Classes
	Assignments on Combinational Circuits	
1 & 2	2 To construct and verify the truth table basic gates(OR, AND, NOT, X-OR, NAND, NOR) To verify De Morgan's theorem and other Boolean identities using IC.	3
3	Realization of AND, OR, NOT, XOR, XNOR using NOR and NAND Gate.	3
4.	To realize given logic expression using basic logic gates and verify using Truth table. To simplify the expression and realize using the gates. To obtain the standard SOP and POS form of the given expression. Simplify using K-Map etc.	3
5.	To implement half Adder & Full Addrer, half subtractor, & Full Subtractor	3
6.	To design and verify: BCD to Gray code converter. & Gray to BCD code converter.	3
7 & 8	• To implement the following: Study the functionalities of 7483 (4 bit binary adder). • To implement the following: a. one bit digital comparator (using XOR and NAND). b. Study the functionalities of7485 (4 bit digital comparator).	3
9 & 10	• To implement the following: a. AND, OR, NOT, XOR, NOR using 74153. b. Construct an 8:1 MUX using Dual 4:1 MUX (74153). • To test a 7 segment LED display using 7447 (BCD to 7 segment decoder).	3
	Assignments on Sequential Circuits	
11 & 12	• To study R-S Flip-Flop using NAND Gate, J-K F/F, D F/F and T F/F using IC 7476. • To construct a 4 bit Serial and Parallel input shift register using 7476 (J K Flip- Flop).	3
13	To set up a 3 bit up counter using J-K Flip-Flop(IC 7476) and configure the 7 segment LED display unit to observe the Output of the counter.	3
14	To construct a Mod-4 Synchronous Counter using JK Flip-flops and verify the truth table.	3
15	To verify the operation of the Ring Counter/Johnson Counter.	3
16	Design of a Linear Feedback Shift Register (LFSR) of length 15/31	3

	using 7474 D-type Flip Flop and 7486 XOR gate. Verify the balanced and run property.	
	Total:	36

Third Semester (Mechanical Engineering)

Fundamentals of Thermodynamics(ME-301)

Weekly Contact Period: 3 L + 0 T **Full Marks: 100 (Credit: 3)**

Sl. No.	Topics	No. of periods
1.	Basic concepts, thermodynamics processes and properties, quasi-static process, thermodynamic equilibrium.	02
2.	Zeroth law, work and heat interactions.	02
3.	First law of thermodynamics: statement, corollaries and application to closed and open systems, steady and unsteady flow processes.	07
4.	Second law of thermodynamics: Kelvin-Planck statement and Clausius statement, reversibility. Carnot cycle. Absolute temperature scale, Inequality of Clausius. Entropy, Exergy, Availability and Irreversibility.	09
5.	Reactive mixtures: Combustion equations, Stoichiometric and actual air-fuel ratios, Lean and rich mixtures, Analysis of actual combustion products.	06
6.	Properties of ideal gas and mixtures: Properties of ideal gas, Dalton's law and Amagats law, Equivalent characteristic gas constant and molecular weight of mixture of perfect gasses,Gibbs-Dalton law and its applications.	03
7.	Properties of pure substance: Phase equilibrium, Diagram and related properties, Gibbs phase rule, Relevant properties of pure substance, Steam Table, Mollier, T-s and p-h diagrams, Steam colorimeters.	08
8.	Psychrometry: Relevant psychrometric properties, Different air-water vapour mixtures, Sling Psychrometer, Psychrometric chart, Psychrometric processes.	05
Total		**42**

Text Books:

1. Engineering Thermodynamics by P.K. Nag
2. Fundamentals of Thermodynamics by R. Sontag & G.V. Wylen

Reference Books:

1. Engineering Thermodynamics: Work and Heat Transfer by G. F. C. Rogers &Y. Mayhew
2. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael C. Boles

Rigid Body Dynamics (AM 302)

Weekly Contact : 3-1-0 **Full Marks : 100 [Credit – 04]**

Prerequisite : Engineering Mechanics

Sl No.	Article	No. of Classes
1	**Introduction** : Kinematics and dynamics, frames of reference, coordinate systems, particle and rigid bodies, scalars, vectors and tensors	01
4	**Kinetics of systems of particles and variables mass problems**	10
5	**Kinetics of particles in accelerating frame of reference** : • Frames with Linear Acceleration, D'Alembert's Principle • Motion in Rotating Frame of Reference	10
6	**Dynamics of rigid bodies in plane motion** : • Definition of Rigid Bodies and Kinematic constraints • Kinematics of Rigid Bodies – Translational Motion, Pure Rotation and General Motion • Linear and Angular Momentum, Kinetic energy • FBD and Laws of Motion • Conservation Principles – linear and angular Momentum, Energy • Impulsive Forces and Moments	10
7	**Dynamics of Motion in Three-dimension** : • Chasle's Theorem and Spheric Motion • Angular Momentum and Inertia Tensor, Kinetic Energy • Free Motion of an Axisymmetric Body – Body cone and Space cone • Euler's Equation, Modified Euler's Equation, Euler Angles, Gyroscopic Acion.	10
	Total	**41**

Text Book : 1. Engineering Mechanics : Dynamics – Meriam & Kraige

Strength of Materials (AM304)

Weekly Contact : 3-1-0 **Full Marks : 100 [Credit – 04]**

Sl No.	Article	No. of Classes
1	Stress, Strain, stress at a point, stress-strain diagrams of ductile and brittle materials, Hooke's Law, Factor of Safety	03
2	Elastic constants, Poisson's ratio, pure shear, shear modulus, bulk modulus, relation among the Elastic constants	04
3	Problems related to stress and strains, thermal stress problems	04

4	Bi-axial stress, principal stress and strain, thin-walled pressure vessels, rings subjected to internal pressure	04
5	Shear force and bending moment diagrams, bending of beams due to transverse load, Euler-Bernoulli's Equation, section modulus, simple bending formula, applications	06
6	Shear stresses in beams, built-up sections, stiffened sections	05
7	Complex stress and strain, Mohr's circle	05
8	Torsion of circular shaft & applications	03
9	Combined bending, torsion and axial thrust & applications	03
10	Deflection of beams subjected to transverse forces – integration method, area-moment theorems	05
11	Energy method – Castigliano's theorem	03
12	Elastic theories of failure & applications	03
	Total	**4848**

Text Book : 1. Elements of Strength of Materials - S.P. Timoshenko and D.H. Young.

Reference Books :

1. Mechanics of Materials – E. Popov
6. A Text Book of Strength of Materials – R.K. Bansal
7. Strength of Materials – F.P. Beer and E.R. Johnston Jr.
4. Strength of Materials (Vol. 1) – D.S. Prakash Rao

PRACTICAL

THERMODYNAMICS LABORATORY (ME 351)

Contact Period : 3 S **Full Marks : 50 [Credit – 02]**

Sl No.	Name of experiments	No. of Classes
1	Study of Fire Tube Boiler Model	03
2	Study of Water Tube Boiler Model	03
3	Study of Two stroke S.I. Engine	03
4	Study of Four stroke S.I. Engine	03
5	Study of Four stroke C.I. Engine	03
6	Determination of Relative Humidity of moist air	03
7	Calibration of Pressure Gauge	03
8	Calibration of Vacuum Gauge	03
	Viva Voce	03
	Total	27

Metallurgy and Materials Engineering : 3rd Semester

Subject: Physics of Materials(MT- 301)

Weekly contact 3-1-0 ***Full Marks: 100 (Credit – 4)***

Sl. No.	Module Name and Topics	No. of Lectures
1.	Electron theory of metals: de Broglie waves, uncertainty principle, wave function and Schrodinger equation; Free electron theory, concepts of density of states, probability interpretation, particle on a chain, potential barrier and quantum tunneling, potential well, qualitative summary of simple harmonic oscillation and Hydrogen atom. Occupation probability and examples.	05
2.	Zone theory: Brillouin zone, free electron band diagrams, potential in a crystal, electron dynamics and concept of holes, conductivity in relation to band structure, band structure of metals, semiconductors and insulators; direct and indirect band-gap semiconductors, intrinsic and extrinsic semiconductors.	08
3.	Ionic conduction - review of defect equilibrium and diffusion mechanisms, theory of ionic conduction, conduction in glasses, effect of stoichiometric and extrinsic defects on conduction, applications in sensors and batteries.	05
4.	Dielectric materials – Dielectric constant and polarization, linear dielectric materials, capacitors and insulators, polarization mechanism, non-linear dielectrics – pyro, piezo and ferro-electric thermo-electric properties, hysteresis and ferro-electric domains and applications.	07
5.	Optical materials – electron-hole recombination, solid-state LED's, Lasers and IR detectors, band gap engineering; Light interaction with materials – transparency, translucency and opacity, refraction and refractive index; reflection, absorption and transmission.	07
6.	Magnetic field, flux density, susceptibility and permeability; Orbital and spin, permanent magnetic moment of atoms, diamagnetism, paramagnetism and pauli paramagnetism, ferro-, anti-ferro and ferri- magnetism, Fe, Co, Ni and alloy additions, ferrites, magnetic hysteresis, soft and hard magnetic materials.	07
7.	Superconductivity.	03
	Total	42

Suggested Reading:

1. Principles of Physical Metallurgy – R. E. Reedhill: CL Engineering
2. Electronic Properties of Materials - Rolf E. Hummel; Springer.
3. The Physics and Chemistry of Materials - Joel I. Gersten and Fredrick W. Smith; Wiley.
4. Solid State Physics - Adrianus J Dekker; Prentice-Hall

Subject: Metallurgical Thermodynamics & Kinetics (MT- 302)

Weekly contact 3-1-0 ***Full Marks: 100 (Credit – 4)***

Sl. No.	Module Name and Topics	No. of Lectures
1.	Fundamental concepts in thermodynamics: system, surroundings, state, extensive and intensive properties and heterogeneous systems, internal energy, heat capacity, enthalpy, isothermal and isobaric processes	06
2.	Laws of thermodynamics: entropy, fugacity, activity, First, Second and Third law	06
3.	Equilibrium: concept of equilibrium and equilibrium constants, equilibrium diagrams, phase stability diagrams	03
4.	Solutions: Solutions and partial molar quantities, laws for ideal and non-ideal solutions, concepts of standard states	04
5.	Phase formation and stability: Phase rule applications, free-energy-composition diagrams and determination of liquidus, solidus and solvus lines, examples, illustrations and problems	04
6.	Fundamental concepts in Kinetics: Definitions, classifications of heterogeneous reactions, fundamental concepts such as rate, rate constant, rate controlling steps	04
7.	Kinetic measurement: order of reaction, activation energy etc., differential and integral form of rate equations, empirical and mechanistic approaches	04
8.	Different types of reactions: methods for evaluating activation energy, derivation of rate equation for reaction control by diffusion, surface reaction, nucleation and growth etc., some examples of rate laws for complicated situations, introduction to thermal analysis.	09
	Total	40

Suggested Reading:

1. Introduction to metallurgical thermodynamics by David R. Gaskell: Taylor & Francis
2. Kinetics of Metallurgical Reactions by H. S. Ray: Science Publisher

Subject: Introduction to Physical Metallurgy (MT- 303)

Weekly contact 3-1-0 ***Full Marks: 100 (Credit – 4)***

Sl. No.	Module Name and Topics	No. of Lectures
1.	Crystallinity in solids, Defects in Crystals: dimensions, origin and their effect on properties; concepts of grains, grain boundaries and texture.	04
2.	Diffusion: Fick's laws and their solutions and applications; Atomic mechanism of different kinds of diffusion; Kirkendall effect, uphill diffusion.	08
3.	Solid solutions: Thermodynamics and theories of alloying; free energy-composition diagrams; stability of phases. Intermetallic compounds and intermediate phases; basic concepts of ordered solid solutions and some common types of orderings in alloys.	06
4.	Solidification of metals and alloys; thermal and constitutional supercooling, cooling curves, concept of phase diagram, coring and micro segregation.	06
5.	Origin, construction, interpretation of equilibrium phase diagrams containing eutectic, eutectoid, peritectic etc; Introduction to ternary equilibrium diagram; Description of some important equilibrium diagrams, viz., Fe-C, Cu-Zn, Cu-Sn, Cu-Al, Ag-Pt, Pb-Sn etc.	08
6.	Significance of structure-properties-processing relationship of engineering materials.	04
7.	Optical microscopy: principles of different techniques, specimen preparation. Principles of various techniques used for measurement, recordings and control of temperatures. Introduction of thermal analysis.	04
	Total	40

Suggested Reading:

1. Modern Physical Metallurgy – R. E. Smallman
2. Principals of Physical Metallurgy – R. E. Reedhill
3. Solid State Phase Transformation - V. Raghavan
4. Phase Transformation of Metals and Alloys –David A. Porter and K. E. Easterling: CRC Press

PRACTICAL

Subject: Physics of MaterialsLab (Sessional pertaining to theory) (MT- 351)

Weekly contact 0-0-3 ***Full Marks: 100 (Credit – 2)***

Sl. No.	Module Name and Topics	No. of Contact hours
1.	Atomic Packing: Model (Software: VESTA)	03
2.	Resistivity and conductivity measurement	06
3.	Measurement of dielectric properties	06
4.	Measurement of Band gap	03
5.	Measurement of ferroelectric properties	06
6.	Measurement of optical properties	06
7.	Measurement of Magnetic properties	09
	Total	39

Metallurgical Thermodynamics & KineticsLab (Sessional pertaining to theory) (MT- 352)

Weekly contact 0-0-3 ***Full Marks: 100 (Credit – 2)***

Sl. No.	Module Name and Topics	No. of Contact hours
1.	Oxidation of Cu, Zn, Al strips.	02
2.	Oxidation of graphite plate	02
3.	Decomposition of $CaCO_3$, $MgCO_3$	02
4.	Measurements of volume of Alcohol-Water mixture	02
5.	Glass tube analogue of heat transfer through refractory	02
6.	Casting defects in ingot castings	02
7.	Proximate analysis of Coal	02
8.	Study on bubbles	02
9	Flow of stacking of materials	02
10.	Reduction of sulphides	02
11.	Cementation of Cu on Fe plate	02
12.	Decomposition voltage of aqueous solutions ($CuSO_4$)	02
13.	Emf study using Pb – Cd alloy	02
14.	Kinetics of mixing	02
15.	Ore- coal reduction kinetics	02
	6 crucibles – Different ore-coal ratio, varying temperature 6 crucibles – Same ore-coal ratio, varying time at same temperature, different time/temperature	
16.	Show that in ore/coal reaction, it is coal that melts; we need different coal and ore samples.	02
	Total	32

Subject: Introduction to Physical Metallurgy Lab (Sessional pertaining to theory) (MT-353)

Weekly contact 0-0-3 ***Full Marks: 100 (Credit – 2)***

Sl. No.	Module Name and Topics	No. of Contact hours
1.	Operation of optical microscope, Specimen preparation (grinding, Polishing and etching) for evaluation of microstructure.	06
2.	Study the Microstructure different of various type of steels	
	(a) Ultra low carbon steel (0.004wt% C steel)	03
	(b) 0.045wt% C steel hot rolled	03
	(c) 0.3 wt % C steel annealed from 900^{o}C	03
	(d) 0.5 wt % C steel annealed from 850^{o}C	03
	(e) 0.8 wt % C steel annealed from 800^{o}C	03
	(f) 1.1 wt % C steel annealed from 900^{o}C	03
3.	Study the Microstructure different of various type of Cast Iron	
	(a) White Cast Iron and Gray Cast Iron	03
	(b) Spheroidal Graphite (SG) Cast Iron and Malleable Cast Iron	03
4.	Study the Microstructure of Copper and its alloys	
	(a) Rolled copper and annealed copper	03
	(b) Different types of Brass (likes α Brass, α-β Brass, β Brass)	03
	(c) Bronze (Al Bronze, P Bronze etc.) and	03
	(d) Sn-Pd alloy, Cast Zn etc	03
5.	Thermocouple calibration	03
	Total	45

Subject: Physics of Materials(MT- 301)

Weekly contact 3-1-0 ***Full Marks: 100 (Credit – 4)***

Sl. No.	Module Name and Topics	No. of Lectures
1.	Electron theory of metals: de Broglie waves, uncertainty principle, wave function and Schrodinger equation; Free electron theory, concepts of density of states, probability interpretation, particle on a chain, potential barrier and quantum tunneling, potential well, qualitative summary of simple harmonic oscillation and Hydrogen atom. Occupation probability and examples.	05
2.	Zone theory: Brillouin zone, free electron band diagrams, potential in a crystal, electron dynamics and concept of holes, conductivity in relation to band structure, band structure of metals, semiconductors and insulators; direct and indirect band-gap semiconductors, intrinsic and extrinsic semiconductors.	08
3.	Ionic conduction - review of defect equilibrium and diffusion mechanisms, theory of ionic conduction, conduction in glasses, effect of stoichiometric and extrinsic defects on conduction, applications in sensors and batteries.	05
4.	Dielectric materials – Dielectric constant and polarization, linear dielectric materials, capacitors and insulators, polarization mechanism, non-linear dielectrics – pyro, piezo and ferro-electric thermo-electric properties, hysteresis and ferro-electric domains and applications.	07
5.	Optical materials – electron-hole recombination, solid-state LED's, Lasers and IR detectors, band gap engineering; Light interaction with materials – transparency, translucency and opacity, refraction and refractive index; reflection, absorption and transmission.	07
6.	Magnetic field, flux density, susceptibility and permeability; Orbital and spin, permanent magnetic moment of atoms, diamagnetism, paramagnetism and pauli paramagnetism, ferro-, anti-ferro and ferri- magnetism, Fe, Co, Ni and alloy additions, ferrites, magnetic hysteresis, soft and hard magnetic materials.	07
7.	Superconductivity.	03
	Total	42

Suggested Reading:

2. Principles of Physical Metallurgy – R. E. Reedhill: CL Engineering
2. Electronic Properties of Materials - Rolf E. Hummel; Springer.
3. The Physics and Chemistry of Materials - Joel I. Gersten and Fredrick W. Smith; Wiley.
4. Solid State Physics - Adrianus J Dekker; Prentice-Hall

Subject: Metallurgical Thermodynamics & Kinetics (MT- 302)

Weekly contact 3-1-0 ***Full Marks: 100 (Credit – 4)***

Sl. No.	Module Name and Topics	No. of Lectures
1.	Fundamental concepts in thermodynamics: system, surroundings, state, extensive and intensive properties and heterogeneous systems, internal energy, heat capacity, enthalpy, isothermal and isobaric processes	06
2.	Laws of thermodynamics: entropy, fugacity, activity, First, Second and Third law	06
3.	Equilibrium: concept of equilibrium and equilibrium constants, equilibrium diagrams, phase stability diagrams	03
4.	Solutions: Solutions and partial molar quantities, laws for ideal and non-ideal solutions, concepts of standard states	04
5.	Phase formation and stability: Phase rule applications, free-energy-composition diagrams and determination of liquidus, solidus and solvus lines, examples, illustrations and problems	04
6.	Fundamental concepts in Kinetics: Definitions, classifications of heterogeneous reactions, fundamental concepts such as rate, rate constant, rate controlling steps	04
7.	Kinetic measurement: order of reaction, activation energy etc., differential and integral form of rate equations, empirical and mechanistic approaches	04
8.	Different types of reactions: methods for evaluating activation energy, derivation of rate equation for reaction control by diffusion, surface reaction, nucleation and growth etc., some examples of rate laws for complicated situations, introduction to thermal analysis.	09
	Total	40

Suggested Reading:

3. Introduction to metallurgical thermodynamics by David R. Gaskell: Taylor & Francis
4. Kinetics of Metallurgical Reactions by H. S. Ray: Science Publisher

Subject: Introduction to Physical Metallurgy (MT- 303)

Weekly contact 3-1-0 ***Full Marks: 100 (Credit – 4)***

Sl. No.	Module Name and Topics	No. of Lectures
1.	Crystallinity in solids, Defects in Crystals: dimensions, origin and their effect on properties; concepts of grains, grain boundaries and texture.	04
2.	Diffusion: Fick's laws and their solutions and applications; Atomic mechanism of different kinds of diffusion; Kirkendall effect, uphill diffusion.	08
3.	Solid solutions: Thermodynamics and theories of alloying; free energy-composition diagrams; stability of phases. Intermetallic compounds and intermediate phases; basic concepts of ordered solid solutions and some common types of orderings in alloys.	06
4.	Solidification of metals and alloys; thermal and constitutional supercooling, cooling curves, concept of phase diagram, coring and micro segregation.	06
5.	Origin, construction, interpretation of equilibrium phase diagrams containing eutectic, eutectoid, peritectic etc; Introduction to ternary equilibrium diagram; Description of some important equilibrium diagrams, viz., Fe-C, Cu-Zn, Cu-Sn, Cu-Al, Ag-Pt, Pb-Sn etc.	08
6.	Significance of structure-properties-processing relationship of engineering materials.	04
7.	Optical microscopy: principles of different techniques, specimen preparation. Principles of various techniques used for measurement, recordings and control of temperatures. Introduction of thermal analysis.	04
	Total	40

Suggested Reading:

1. Modern Physical Metallurgy – R. E. Smallman
2. Principals of Physical Metallurgy – R. E. Reedhill
3. Solid State Phase Transformation - V. Raghavan
4. Phase Transformation of Metals and Alloys –David A. Porter and K. E. Easterling: CRC Press

PRACTICAL

Subject: Physics of MaterialsLab (Sessional pertaining to theory) (MT- 351)

Weekly contact 0-0-3 ***Full Marks: 100 (Credit – 2)***

Sl. No.	Module Name and Topics	No. of Contact hours
1.	Atomic Packing: Model (Software: VESTA)	03
2.	Resistivity and conductivity measurement	06
3.	Measurement of dielectric properties	06
4.	Measurement of Band gap	03
5.	Measurement of ferroelectric properties	06
6.	Measurement of optical properties	06
7.	Measurement of Magnetic properties	09
	Total	39

Metallurgical Thermodynamics & KineticsLab
(Sessional pertaining to theory) (MT- 352)

Weekly contact 0-0-3 ***Full Marks: 100 (Credit – 2)***

Sl. No.	Module Name and Topics	No. of Contact hours
1.	Oxidation of Cu, Zn, Al strips.	02
2.	Oxidation of graphite plate	02
3.	Decomposition of $CaCO_3$, $MgCO_3$	02
4.	Measurements of volume of Alcohol-Water mixture	02
5.	Glass tube analogue of heat transfer through refractory	02
6.	Casting defects in ingot castings	02
7.	Proximate analysis of Coal	02
8.	Study on bubbles	02
9	Flow of stacking of materials	02
10.	Reduction of sulphides	02
11.	Cementation of Cu on Fe plate	02
12.	Decomposition voltage of aqueous solutions ($CuSO_4$)	02
13.	Emf study using Pb – Cd alloy	02
14.	Kinetics of mixing	02
15.	Ore- coal reduction kinetics	02
	6 crucibles – Different ore-coal ratio, varying temperature 6 crucibles – Same ore-coal ratio, varying time at same temperature, different time/temperature	
16.	Show that in ore/coal reaction, it is coal that melts; we need different coal and ore samples.	02
	Total	32

Subject: Introduction to Physical Metallurgy Lab (Sessional pertaining to theory) (MT-353)

Weekly contact 0-0-3 ***Full Marks: 100 (Credit – 2)***

Sl. No.	Module Name and Topics	No. of Contact hours
1.	Operation of optical microscope, Specimen preparation (grinding, Polishing and etching) for evaluation of microstructure.	06
2.	Study the Microstructure different of various type of steels	
	(a) Ultra low carbon steel (0.004wt% C steel)	03
	(b) 0.045wt% C steel hot rolled	03
	(c) 0.3 wt % C steel annealed from 900^{o}C	03
	(d) 0.5 wt % C steel annealed from 850^{o}C	03
	(e) 0.8 wt % C steel annealed from 800^{o}C	03
	(f) 1.1 wt % C steel annealed from 900^{o}C	03
3.	Study the Microstructure different of various type of Cast Iron	
	(a) White Cast Iron and Gray Cast Iron	03
	(b) Spheroidal Graphite (SG) Cast Iron and Malleable Cast Iron	03
4.	Study the Microstructure of Copper and its alloys	
	(a) Rolled copper and annealed copper	03
	(b) Different types of Brass (likes α Brass, α-β Brass, β Brass)	03
	(c) Bronze (Al Bronze, P Bronze etc.) and	03
	(d) Sn-Pd alloy, Cast Zn etc	03
5.	Thermocouple calibration	03
	Total	45

MINING ENGINEERING (3rd SEMESTER)

DRILLING AND BLASTING (MN 301)

Weekly contact : 3– 0 - 0 Full Marks: 100 [Credit: 3]

Sl. No.	Module Name and topics	No. of Lectures
1	**Principles of Drilling**: Principles of rock drilling, drillability, and mechanics of drilling. Different exploratory and production drilling systems- classification and equipments	04
2	**Drill Bits:** Various types of drill bits. Thrust feed and rotation, alignment and deviation in drilling	02
3	**Oil and Gas Drilling:** components of drill rigs, rods, casing, mud systems, and monitoring, directional drilling	04
4	**Explosives:** Properties of explosives. Different low and high explosives, Bulk Explosive systems	04
5	**Accessories to Explosives:**Fueses, detonators, and shock tube initiation system	02
6	**Blasting Methods:**Systems of blasting in underground and surface mines. Misfires, blown out shots, incomplete detonation- causes and remedial measures. Secondary and Controlled Blasting techniques.	04
7	**Blast Design:**Design of blasting rounds in underground and surface mines	04
8	**Handling of Explosives:**Transport of explosives, storage and handling	02
9	**Alternate Rock Breaking systems:**Substitutes for explosives and their applications-hydrox, Cardox, Hydraulic coal burster, airdox, pulsed infusion shot firing.	02
10	**Mechanics of Blasting:**Factors affecting rock breakage, Crater theory and its applications, theories of rock breakage using explosives.	02
	TOTAL	30

Suggested Reading:

1. Das S. K. 2001. *Explosives and Blasting Practices in Mines.* Lovely Prakashan, Dhanbad.
2. Fanchi J. R., Arnold K., Clegg J D, Holstein E. D. and Warner H. R. 2007. *Petroleum Engineering Handbook: Drilling Engineering*. Society of Petroleum Engineers. 763 p.
3. Konya K. J. and Walter E. J. 1990. Surface Blast Design. Prentice Hall. 303 p.

4. Mitchell R. F. and Miska S. 2010. Fundamentals of Drilling Engineering. Society of Petroleum Engineers.696 p.
5. Pradhan G. K. and Sandhu M. S.2002. *Blasting Safety Manual*. IME Publications, Calcutta. 271 p.

MINE DEVELOPMENT (MN 302)

Weekly contact : 3– 0 - 0 Full Marks: 100

[Credit: 3]

Sl. No.	Module	No. of Lectures
1	**Explanation of Mining Terminologies**: various terminologies used in describing various machines, features, operations and design of various types of mines. Terminologies used in reconnaissance, prospecting and exploration of minerals.	2
2	**Prospecting and Exploration:** Mode of occurrence of commercial-grade deposits of a few important minerals, *viz.*, Fe, Mn, Cu, Pb-Zn, Al, Coal etc. Geological prospecting and exploration methods. Indications of ore.	2
3	**Opening-up of Deposits:** Choice of mode of entry – adit, shaft, decline and combined mode, their applicability, number and disposition.	2
4	**Vertical and Inclined Shafts:** Location, shape, size, and organisation of shaft sinking, construction of shaft collar, shaft fittings.	2
5	**Shaft Sinking Operations:** Ground breaking and muck disposal – tools and equipment, lining; ventilation, lighting and dewatering; sinking in difficult and water-bearing ground	2
6	**Insets:** Design, excavation and lining	2
7	**Mechanised Sinking:** Simultaneous sinking and lining; slip-form method of lining; high speed sinking	2
8	**Shaft Boring:** Methods and equipment.	2
9	**Special Attributes**: Widening and deepening of inclined and vertical shafts; staple shafts, raised shafts.	2
10	**Fundamentals of Underground Mine Layouts**: different types of underground mine layouts; pit-top and pit-bottom layouts	2
11	**Roof Supports**: Classification of coal seam roofs, theories of the mechanics of strata behaviour, Timber props and cogs; friction/hydraulic props and chocks; other steel supports;	2
12	**Roof bolting**: types of roof bolts; function, applicability and advantage of roof bolting and cable bolting	2
13	**Self Advancing Powered Supports:** classification, components, design aspects and safety features	2
14	**Systematic Support Rules**; supporting scheme of development gallery, Bord and Pillar and Longwall faces, depillaring district; withdrawal of support.	2
15	**Stowing:** Conditions requiringstowing in mines; types of stowing; suitable materials for hydraulic stowing; stowing plant and stowing range; hydraulic	2

	gradient and hydraulic profile.	
TOTAL		30

Suggested Reading:

1. Darling P. (Editor). 2011. *SME Mining Engineering Handbook*. Third edition. Society for Mining Metallurgy and Exploration. 1984 p.
2. Deshmukh D. J. (2010) *Elements of Mining Technology. Vol.1* (8th Edition). Denett and Company, Nagpur. 424 p.
3. Hartman H. L. and Mutmansky J. M. 2002. *Introductory Mining Engineering*, 2nd Edition. John Wiley. 584 p.
4. IMM. 2005. *Shaft Engineering*. Institution of Mining and Metallurgy, London in association with CRC Press. 405 p.
5. Mukherjee S N (1993) - *Longwall Machinery and Mechanisation*. A.M. Publishers. Dhanbad. 431p.
6. Peng S. S. (2006) - *Longwall Mining*. Second edition. Published by Syd S. Peng. 636p.
7. Singh R D (1997) *Principles and Practices of Modern coal Mining*. New Age Publisher, New Delhi.720 p.

INDUSTRIAL VISIT TO UNDERGROUND COAL MINES (MN 351)

FM 50 (Credit: 1)

Activities	**No. of days**
Students will be taken for local/ short excursions to a few underground coal mines in Ranigunj/ Jharia or other nearby coal-fields. They will be shown and explained practical aspects of various features and unit operations undertaken in such mines.	06

MINI PROJECT I (MN 371)

Full Marks 50 [Credit: 2]

Activities
Students will be required to undertake technical work on a technical topic and carry out independent study under the guidance of a Teacher. The result of the study will be submitted in the form of a term paper.

SEMINAR AND TECHNICAL REPORT WRITING (MN 352)

Weekly Contact: 0 – 0 – 2 Full Marks 50 [Credit: 1]

Activities
Students will be required to prepare a technical article on a chosen relevant technical topic and prepare presentation slides for the same. The result of the study will be submitted in the form of a term paper. Students will be required to present a seminar talk on the same. Also students will be required to acquaint themselves with the structure, format and content of a technical report.

MODELING AND SIMULATION (MN 354)

Weekly Contact: 0 – 0 – 2 Full Marks 50 [Credit: 2]

Activities
Students will be Introduced to modelling and simulation concepts. System analysis and classification. Abstract and simulation models. Continuous, discrete, and combined models. Heterogeneous models. Pseudorandom number generation and testing. Queuing systems. Monte Carlo method. Continuous simulation, numerical methods, Simulation experiment control. Visualization and analysis of simulation results.