MA1001D MATHEMATICS I

Pre-requisites: Nil

Total hours: 39

Course Outcomes:
Students will be able to:
CO1: Find the limits, check for the continuity and differentiability of functions of a single variable as well as several variables.
CO2: Test for the convergence of sequences and series of numbers as well as functions.
CO3: Formulate different mensuration problems as multiple integrals and evaluate them.
CO4: Use techniques in vector differential calculus to solve problems related to curvature, surface normal and directional derivative.
CO5: Find the parametric representation of curves and surfaces in space and will be able to evaluate the integral of functions over curves and surfaces.

Module 1: (13 Lecture hours)

Real valued function of real variable: Limit, Continuity, Differentiability, Local maxima and local minima, Curve sketching, Mean value theorems, Higher order derivatives, Taylor's theorem, Integration, Area under the curve, Improper integrals.

Function of several variables: Limit, Continuity, Partial derivatives, Partial differentiation of composite functions, Differentiation under the integral sign, Local maxima and local minima, Saddle point, Taylor's theorem, Hessian, Method of Lagrange multipliers.

Module 2: (13 Lecture hours)


Double integral, Triple integral, Change of variables, Jacobian, Polar coordinates, Applications of multiple integrals.

Module 3: (13 Lecture hours)

Parameterised curves in space, Arc length, Tangent and normal vectors, Curvature and torsion, Line integral, Gradient, Directional derivatives, Tangent plane and normal vector, Vector field, Divergence, Curl, Related identities, Scalar potential, Parameterised surface, Surface integral, Applications of surface integral, Integral theorems: Green's Theorem, Stokes' theorem, Gauss' divergence theorem, Applications of vector integrals.

References:
MA1002D MATHEMATICS II

Pre-requisites: Nil

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Total hours: 39

Course Outcomes
Students will be able to:
CO1: Test the consistency of system of linear equations and then solve it.
CO2: Test for linear independence of vectors and perform orthogonalisation of basis vectors.
CO3: Diagonalise symmetric matrices and use it to find the nature of quadratic forms.
CO4: Formulate some engineering problems as ODEs and hence solve them.
CO5: Use Laplace transform and its properties to solve differential equations and integral equations.

Module 1: (16 Lecture hours)

System of Linear equations, Gauss elimination, Solution by LU decomposition, Determinant, Rank of a matrix, Linear independence, Consistency of linear system, General form of solution.
Vector spaces, Subspaces, Basis and dimension, Linear transformation, Rank-nullity theorem, Inner-product, Orthogonal set, Gram-Schmidt orthogonalisation, Matrix representation of linear transformation, Basis changing rule.
Types of matrices and their properties, Eigenvalue, Eigenvector, Eigenvalue problems, Cayley-Hamiltonian theorem and its applications, Similarity of matrices, Diagonalisation, Quadratic form, Reduction to canonical form.

Module 2: (13 Lecture hours)

Ordinary Differential Equations (ODE): Formation of ODE, Existence and uniqueness solution of first order ODE using examples, Methods of solutions of first order ODE, Applications of first order ODE.

Module 3: (10 Lecture hours)

Gamma function, Beta function: Properties and evaluation of integrals.
Laplace transform, Necessary condition for existence, General properties, Inverse Laplace transform, Transforms of derivatives and integrals, Differentiation and Integration of transform, Unit-step function, Shifting theorems, Transforms of periodic functions, Convolution, Solution of differential equations and integral equations using Laplace transform.

References:
PH1001D PHYSICS

Pre-requisites: Nil

Total hours: 39

Course Outcomes:
Students will be able to:
CO1: To enable students to apply relevant fundamental principles of modern physics to problems in engineering.
CO2: To develop knowledge of basic principles of Quantum Physics
CO3: Acquire knowledge of the basic physics of a collection of particles and the emergent macroscopic properties.
CO4: Apply principles of quantum and statistical physics to understand properties of materials

Module 1: (12 hours):
Particle nature of radiation – Photoelectric effect, Compton effect, Wave nature of matter – matter waves, wave packets description, phase and group velocity, uncertainty principle. Formulation of Schrödinger equation, physical meaning of wave function, expectation values, time-independent Schrödinger equation, quantization of energy for bound particles. Application of time-independent Schrödinger equation to free particle, infinite well, finite well, barrier potential, tunneling.

Module 2: (14 hours):
Simple Harmonic Oscillator, two-dimensional square box, the scanning tunneling microscope. Wave function for two or more particles, indistinguishable particles, symmetry and anti-symmetry under exchange of particles, Pauli’s exclusion principle, electronic configurations of atoms. Quantum model of a solid – periodicity of potential and bands, E – k diagram, effective mass, band gap.

Module 3: (13 hours):
Microstates and macrostates of a system, equal probability hypothesis, Boltzmann factor and distribution, ideal gas, equipartition of energy, Maxwell speed distribution, average speed, RMS speed, Quantum distributions - Bosons and Fermions, Bose-Einstein and Fermi-Dirac distribution, applications.

References:

Pre-requisites: Nil

Total hours: 39

Course Outcomes:
Students will be able to:
CO1: Acquire knowledge about separation strategies, identification and characterization of molecules
CO2: Understand the causes and mechanism of corrosion and understand its prevention methods
CO3: Attain knowledge about electrochemical reactions and their current applications
CO4: Comprehend the principles of industrial catalytic processes and enzyme catalysis

Module 1: (14 hours)

Chromatography – Retention and Separation factors, Theoretical plates, Instrumentation and uses of Gas Chromatography and High Performance Liquid Chromatography
Thermal analysis – Thermogravimetry, Differential Scanning Calorimetry and Differential Thermal Analysis

Module 2: (12 hours)

Electrochemical corrosion – Mechanisms, control and prevention.
Cyclic voltammetry, Switching potentials, Cathodic and anodic peak currents Potentiometry, Fuel cells – Types and applications
Liquid crystals – Phase types, uses in displays and thermography.

Module 3: (13 hours)

Catalysis – Homogeneous and heterogeneous catalysis, Organometallic compounds, 18-electron rule, Oxidative addition, Reductive elimination, insertion and Elimination reactions, Wilkinson’s catalyst in alkene hydrogenation, Zeigler-Natta catalysis in polymerization of olefins.
Enzyme catalysis – Mechanisms, significance of Michaelis – Menten constant, Turnover number, Co-enzymes and cofactors

References:
MS1001D PROFESSIONAL COMMUNICATION

Pre-requisites: Nil

Total hours: 39

Course Outcomes
Students will be able to:

CO1: Ability to distinguish the different types of meaning for constructive criticism, by developing a comprehensive understanding of the extensive vocabulary and usage in formal English language.
CO2: Learn and practice principles related to good formal writing.
CO3: Develop competence in group activities such as group discussions, debates, mock interviews, etc. by practicing the integration of unique qualities of nonverbal and verbal styles.
CO4: Deliver clear and effective presentation of ideas in the oral / written medium and to acquire the ability to modify it according to the target audience.

Module 1: (12 hours)
Role and importance of verbal communication, Everyday active vocabulary, Common words used in transitions, enhancing vocabulary, affixes and changes in pronunciation and grammatical functions, words often confused in pronunciation and usage. Passage comprehension- skimming, scanning techniques, note making, note taking and summarizing. Deciphering meaning from contexts. Two types of meaning- literal and contextual. Constructive criticism of speeches and explanations.

Module 2: (15 hours)
Fundamental grammar, Simple structures, passivizing the active sentences, reported speech, the judicious use of tenses and moods of verbs, forming questions and conversion from questions to statements and vice versa, forming open –ended and close- ended questions. Words and style used for formal and informal communication. Practice converting informal language to formal, the diction and the style of writing. Dealing with the nuances of ambiguous constructions in language. Learning authoritative writing skills, polite writing and good netiquette. Writing for internships and scholarships.

Module 3: (12 hours)
Kinesics, Proxemics, Haptics, and other areas of non-verbal communication, fighting communication barriers, positive grooming and activities on the same. Different types of interviews, and presentation- oral, poster, ppt. Organizing ideas for group discussions, the difference between GD and debates.

References:
Course Outcomes:
Students will be able to:
CO1: Determine the resultants of a force system
CO2: Solve rigid body statics problems using equations of equilibrium and principle of virtual work
CO3: Perform kinematic analysis of a particle
CO4: Solve particle dynamics problems using Newton's laws, energy methods and momentum methods

Module 1: Basic Concepts (13 hours)
Important vector quantities: position vector, moment of a force about a point, moment of a force about an axis, the couple and couple moment, couple moment as a free vector, moment of a couple about a line.
Equivalent force systems: translation of a force to a parallel position, resultant of a force system, simplest resultant of special force systems, distributed force systems, reduction of general force system to a wrench.

Module 2: Statics (13 hours)
Equations of equilibrium: free-body diagram, free bodies involving interior sections, general equations of equilibrium, problems of equilibrium, static indeterminacy.
Applications of equations of equilibrium: Trusses: solution of simple trusses using method of joints and method of sections; Friction forces: laws of Coulomb friction, simple contact friction problems; Cables and chains.
Properties of surfaces: first moment and centroid of plane area, second moments and product of area for a plane area, transfer theorems, rotation of axes, polar moment of area, principal axes.
Method of virtual work: principles of virtual work for rigid bodies and its applications.

Module 3: Dynamics (13 hours)
Kinematics of a particle: introduction, general notions, differentiation of a vector with respect to time, velocity and acceleration calculations in rectangular coordinates, velocity and acceleration in terms of path variables and cylindrical coordinates, simple kinematical relations and applications.
Dynamics of a particle: introduction, Newton’s law for rectangular coordinates, rectilinear translation, Newton’s law for cylindrical coordinates, Newton’s law for path variables, energy and momentum methods: introduction, conservative force field, conservation of mechanical energy, alternative form of work-energy equation, impulse and momentum relations, moment-of-momentum equation.

References:
ZZ1002D ENGINEERING GRAPHICS

Pre-requisites: Nil

Total hours: 52

Course Outcomes:
Students will be able to:
CO2: Represent any engineering object by its orthographic views.
CO3: Convert orthographic views of an engineering object into its isometric view.
CO4: Enhance the capacity of visualization of engineering objects.

Module 1: (15 hours)
Introduction; drawing instruments and their uses; lines, lettering and dimensioning; geometrical construction; constructions of plain, diagonal and vernier scales; orthographic projection—first and third angle projections; orthographic projection of points on principal, profile, and auxiliary planes.

Module 2: (17 hours)
Orthographic projection of straight line in simple and oblique positions; application of orthographic projection of line; orthographic projection of planes in simple and oblique position on principal and profile planes; orthographic projection of lines and planes on auxiliary planes.

Module 3: (20 hours)
Orthographic projection of solids in simple and oblique positions on principal and profile planes; orthographic projections of solids in oblique position using auxiliary plane method; orthographic projection of spheres; orthographic projection of solids in section; development of surfaces of solids; method of isometric projection.

References:
ZZ1003D BASIC ELECTRICAL SCIENCES

Pre-requisites: None

Total hours: 39

Course Outcomes:
Students will be able to:

CO1: Design simple resistive circuits for various applications in Electrical and Electronics engineering.

CO2: Design simple magnetic circuits and inductive components for signal and power processing.

CO3: Carry out design verification calculations, power and power loss calculations, voltage drop calculations etc.

in single phase ac circuits.

CO4: Analyze Amplifiers and Digital Circuits in terms of critical parameters and complexity.

CO5: Design sub modules for systems/ Solutions for real life problems using suitable sensors/transducers, amplifiers, data converters and digital circuits.

Module 1: (11 hours)

Analysis of Resistive Circuits:
v-i relationship for Independent Voltage and Current Sources
Solution of resistive circuits with independent sources- Node Voltage and Mesh Current Analysis, Nodal Conductance Matrix and Mesh Resistance Matrix and symmetry properties of these matrices
Source Transformation and Star-Delta / Delta-Star Conversions to reduce resistive networks
Circuit Theorems - Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.

Magnetic Circuits:
MMF, Magnetic Flux, Reluctance, Energy stored in a Magnetic Field, Solution of Magnetic Circuits.

Two Terminal Element Relationships:

Capacitance – Electrostatics, Capacitance, Parallel Plate Capacitor, Capacitors in series and parallel, Energy stored in Electrostatic Field, v-i relationship for Inductance and Capacitance

Module 2: (9 hours)

Single Phase AC Circuits:
Alternating Quantities - Average Value, Effective Value, Form and Peak factors for square, triangle, trapezoidal and sinusoidal waveforms.

Phasor representation of sinusoidal quantities - phase difference, Addition and subtraction of sinusoids, Symbolic Representation: Cartesian, Polar and Exponential forms.
Analysis of a.c circuits - R, RL, RC, RLC circuits using phasor concept, Concept of impedance, admittance, conductance and susceptance.

Power in single phase circuits - instantaneous power, average power, active power, reactive power, apparent power, power factor, complex power, solution of series, parallel and series parallel a.c circuits.

Module 3 (11 hrs)

Sensors and Transducers:
principles of piezoelectric, photoelectric, thermoelectric transducers, thermistors, strain gauge, LVDT, etc, Measurement of temperature, pressure, velocity, flow, pH, liquid level, etc.

Basics of Signal Amplification:
(Explanation based on two port models is only envisaged) – voltage gain, current gain and power gain, amplifier saturation, types of amplifiers (voltage, current, transconductance and transresistance amplifiers) and relationship between these amplifier models, frequency response of amplifiers, single time constant networks.

Operational amplifier basics:
Ideal op-amp, inverting, noninverting, summing and difference amplifiers, integrator, differentiator.
Module 4 (8 hrs)
Digital Electronics:
Review of number systems and Boolean algebra, Logic Gates and Truth Tables, Simplification of Boolean functions using Karnaugh map (upto 4 variable K-maps), Implementation of Simple combinational circuits (Adder, Code Converters, 7-Segment Drivers, Comparators, Priority Encoders, etc) - MUX-based implementation of combinatorial circuits, Sequential circuits: SR,JK, T and D flipflops, counters and registers using D flip flops, Basics of data converters (at least one ADC and DAC).

References:

2. K.S. Suresh Kumar, Electric Circuits & Networks, Pearson Education, 2009
**ZZ1004D Computer Programming**

Pre-requisites: Nil.

**Total hours: 26**

**Course Outcomes:**
Students will be able to:

CO1: Design of algorithms for simple computational problems.

CO2: Express algorithmic solutions in the C programming language.

**Module 1: (10 hours)**
Data Types, Operators and Expressions: Variables and constants - declarations - arithmetic and logical operators – Assignment operator – Input/Output.
Control Flow: Statements and blocks – if-else, switch, while, for and do-while statements – break and continue – goto and labels.

**Module 2: (08 hours)**

**Module 3: (08 hours)**
Aggregate data types: Single and multidimensional arrays, structures and unions – Pointers to arrays and structures – passing arrays and pointers as arguments to functions.

**References:**
PH1091D PHYSICS LAB

Pre-requisites: Nil

Total hours: 26

Course Outcomes:
Students will be able to:
CO1: To develop experimentation skills and understand importance of measurement practices in Science & Technology.
CO2: Develop analytical skills for interpreting data and drawing inferences.
CO3: Estimate the nature of experimental errors and practical means to obtain errors in acquired data.
CO4: Develop skills for team work and technical communication and discussions.
CO5: Apply theoretical principles of modern physics to analysis and measurements performed in the laboratory.

LIST OF EXPERIMENTS

1. Magnetic Hysteresis loss - Using CRO
2. Band gap using four probe method
3. Hall effect - determination of carrier density, Hall coefficient and mobility
4. Solar cell characteristics
5. Double refraction – measurement of principle refractive indices.
7. Measurement of e/m of electron – Thomson’s experiment
8. Determination of Planck’s constant
9. Measurement of electron charge – Millikan oil drop experiment
10. Determination of magnetic field along the axis of the coil
11. Newton’s rings
12. Laurent’s Half shade polarimeter – determination of specific rotatory power
13. Study of P-N junction
15. Laser – measurement of angle of divergence & determination of $\lambda$ using grating
17. Mapping of magnetic field
18. Temperature measurement by using thermocouple

NOTE: Any 8 experiments have to be done.

Reference:
3. S.L. Gupta and V. Kumar, Practical physics, Pragathi Prakash (2005)
Pre-requisites: Nil

Total hours: 26

Course Outcomes:
Students will be able to:
CO1: Acquire practical knowledge on the separation of mixtures and their identification
CO2: Understand chirality and the specific rotation of a compound
CO3: Attain practical experience in the synthesis of new molecules
CO4: Apply different techniques to quantitatively determine the amount of components

List of Experiments:
1. Determination of specific rotation by polarimetry
2. Potentiometric titrations
3. Estimation of ions using complexometry
4. Determination of strength of an acid using pH meter
5. Analysis of organic and inorganic compounds
6. Conductometric titrations using acid or mixture of acids
7. Separation of compounds using chromatography
8. Colorimetric estimations
9. Determine the eutectic temperature and composition of a solid two component system
10. Synthesis of organic/inorganic compounds and their characterizations
11. Determination of molecular weight of polymers

Note: Selected experiments from the above list will be conducted

References:
ZZ1091D Workshop I

Pre-requisites:  Nil

Total hours: 39

Course Outcomes (COs):
Students will be able to:
CO1: Perform experiments to ascertain the quality requirements and quality testing procedures of selected building material, viz., cement, fine aggregate, coarse aggregate, concrete, timber and steel.
CO2: Identify and evaluate various driver characteristics as driver of a vehicle.
CO3: Acquire knowledge about basic civil engineering practices of brick masonry, plumbing and surveying.
CO4: Perform wiring estimation and costing for simple building/commercial electrical wiring systems.
CO5: Use commonly employed wiring tools and lighting and wiring accessories.
CO6: Adopt electrical safety measures in using and servicing household appliances.

Civil Engineering Workshop (24 hours)
1. Introduction to Surveying – Linear measurements – Hands on session on Setting out of a small residential building.
2. Introduction to Levelling – Hands on sessions using Dumpy level – Levelling exercise.
3. Introduction to Total Station – Hands on sessions - small exercises.
4. Tests on cement and aggregates: Demonstration of standard consistency, initial and final setting time of cement – Hands on sessions - Compressive strength test on cement mortar cubes and sieve analysis for coarse and fine aggregates.
5. Tests on hardened concrete, brick, timber and steel: Demonstrations on hardness tests (Rockwell hardness), impact tests (Charpy and Izod) on steel specimens-demonstration on properties of timber – Hands on sessions - Compression test on concrete cubes, bricks and tension test on mild steel specimen.
7. Water supply and sanitation: Study of water supply pipe fittings – tap connections – sanitary fittings
8. Various tests on Driver characteristics – Visual acuity and colour blindness, peripheral vision, depth perception, driver reaction time.

Electrical Engineering Workshop (15 hours)
1. (a) Familiarization of wiring tools, lighting and wiring accessories, various types of wiring systems.
   (b) Wiring of one lamp controlled by one switch.
2. (a) Study of Electric shock phenomenon, precautions, preventions, Earthing.
   (b) Wiring of one lamp controlled by two SPDT Switches and one 3 pin plug socket independently.
3. (a) Familiarization of various types of Fuses, MCBs, ELCBs, etc.
   (b) Wiring of fluorescent lamp controlled by one switch with ELCB & MCB.
4. (a) Study of estimation and costing of wiring.
   (b) Wiring, control and maintenance of domestic appliances like Mixer machine, Electric Iron, fan, motor, etc.

References
Pre-requisites: Nil

**ZZ1092D WORKSHOP II**

Total hours: 39  
Course Outcomes (COs):  Students will be able to:  
CO1: Ability to select suitable material for a given purpose applying knowledge of material properties and processing.  
CO2: Ability to use measuring devices like Vernier Calipers, Micrometers, etc.  
CO3: Ability to fabricate simple components using basic manufacturing processes like Casting, Forming, Joining and Machining.  
CO4: Ability to sequence various operations so as to execute the task within minimum time.  
CO5: Perform diagnostic measurements using analog and digital meters for troubleshooting electronic systems.  
CO6: Select appropriate electronic components for a given design task and assemble the prototype on breadboard.  
CO7: Troubleshoot electronic boards used in various household appliances.  
CO8: Perform cost estimation and costing of PCB soldering and carry out the soldering.  

**Mechanical Engineering Workshop (24 hours)**  
The course is intended to expose the student to various manufacturing processes through hands on training in different sections of Central Workshop. During the course, the student learns the properties and selection of different materials and acquires the skill in using various tools and measuring devices.  
1. Carpentry: Study of tools and joints – planing, chiseling, marking and sawing practice, one typical joint- Tee halving/Mortise and Tenon/ Dovetail  
4. Smithy: Study of tools. Forging of square or hexagonal prism/chisel/bolt  
6. Sheet Metal: Study of tools, selection of different gauge sheets, types of joints. Fabrication of a tray or a funnel  

**Electronics Engineering Workshop (15 hours)**  
1. (a) Familiarization of electronic components, colour code, multimeters.  
   (b) Bread board assembling-Common emitter amplifier.  
2. (a) Study of soldering components, solders, tools, heat sink.  
   (b) Bread board assembling-phase shift oscillator.  
3. (a) Soldering practice-Common emitter amplifier.  
   (b) Soldering practice-Inverting amplifier circuit.  
4. (a) Study of estimation and costing of soldering PCB, 3 phase connections.  
   (b) PCB wiring and fault Identification of appliances like Electronic Ballast, fan regulator, inverter, UPS, etc.  

References  
BT1001D INTRODUCTION TO LIFE SCIENCE

Pre-requisites: Nil

Total hours: 26

Course Outcomes:

CO1: Comprehend the chemical and molecular basis of life.

CO2: Summarize about the basic molecules of life- proteins, lipids, DNA, and RNA

CO3: Develop idea about cell, its structure, functions and significance of compartmentalization

CO4: Students will describe the concepts in ecology and biodiversity and its impact on global change

Module 1: (09 hours)

Origin and evolution of life, Biogenesis and Louis Pasteur, Oparin-Haldane hypothesis, Darwin’s view on natural selection. unity and diversity of life, Chemistry of life, introduction to structure and function of the biological macromolecules like carbohydrates, proteins, lipids, DNA and RNA

Module 2: (09 hours)

Prokaryotic and eukaryotic cells, structure and organization of cells, intracellular compartmentalization, functions of various organelles. Extracellular components and cell-cell communication, overview of Mitosis and Meiosis, basic concepts in energy transformation and photosynthesis.

Module 3: (08 hours)

Principles of Mendelian inheritance and chromosomal basis of heredity, linked genes, genetic disorder. Ecosystems and restoration ecology, energy flow, chemical and nutrient cycling, primary production in ecosystems, conservation of biodiversity.

References:

Pre-requisites: Nil

Total hours: 26

Brief Syllabus:

Different hypotheses on the origin and evolution of life, Diversity of Life, Chemistry of life, structure and functions of biological macromolecules, structure and organization of cells, compartmentalization and its significance, cell division, energy transformation, Mendel's Law of inheritance, Ecosystems and restoration ecology.