**MTH 111.3 Engineering Mathematics I (3-2-0)**

**Evaluation:**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | 50 | - | 50 |
| Final | 50 | - | 50 |
| Total | 100 | - | 100 |

**Course Objectives:**
After the completion of this course prospective engineers will be able to apply the concepts of calculus, analytic geometry and vectors in their professional courses.

**Course Contents:**

**1. Differential Calculus (15 hrs)**
Review of sets and functions, limit, continuity and differentiability of functions, higher order derivative, Leibnitz rule and its application, Rolle's theorem, Lagrange's and Cauchy mean value theorems, maxima and minima of a function of a single variable, indeterminate form and L-Hospitals rule, curvature, asymptotes and curve tracing.

**2. Integral Calculus (15 hrs)**
Review of techniques of integration (method of Substitution, integration by parts, special trigonometric forms and rational functions) standard integrals, definition and properties of definite integrals (area, arc length, volume and surfaces areas of revolution), Simpson's rule, trapezoidal rule and use of Popus theorem, moments of inertia and centroid.

**3. Analytic Geometry and Vector Algebra (15 hrs)**
Review of vectors and scalars, resolution of vectors, scalar, scalar and vector product of two and more vectors, vectorequation of lines and planes, transformation of axes, parabola, ellipse, hyperbola and polar equation of conics.

**Textbook:**
1. Thomas and Finney, *Calculus and Analytic Geometry*, Narosa Publishing House, New Delhi.

**Reference Books:**
1. M.B. Simgh and B.C. Bajracharya, *A Text Book of Vector Analysis*, Sukunda Pustak Bhawan, Bhotahity, Kathmandu
2. M.B. Singh and B.C. Bajracharya, *Differential Calculus*, Sukunda Pustak Bhawan, Bhotahity, Kathmandu
3. Lalji Prasad, *Higher Co-ordinate Geometry*, Para Mount Publication, Patna-4

**PHY 102.4 Physics (4-2-2)**

**Evaluation:**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | 30 | 20 | 50 |
| Final | 50 | - | 50 |
| Total | 80 | 20 | 100 |

**Course Objectives:**

The main objectives of this course is to make able:

1. To apply the theory of simple Harmonic motion in different elastic systems.
2. To apply theory of wave propagation and knowledge of resonance.
3. To apply and analyze the Optical properties in different optical systems.
4. To make use of fundamentals of electromagnetic equipment.
5. To use the knowledge of basic physics in different engineering fields.

**Course Contents:**

**1. Simple Harmonic Motion (3 hrs)**

Equation of linear simple harmonic motion, Application of SHM in suspended spring mass system and simple pendulum, Angular simple harmonic motion and its application in Physical (Bar) pendulum, Energy consideration.

**2. Waves in Elastic Media (5 hrs)**

Mechanical waves, Types of waves, Travelling waves, Wave speed, Power and intensity, Reflection, Refraction and interference, Standing waves, Resonance.

**3. Sound Waves (6 hrs)**

Propagation and speed of sound wave, Displacement and pressure wave, Power and intensity, Reflection and refraction, velocity of sound from air column method, Beats, Doppler effect, Effect of high speed, Production and uses of ultrasound.

**4. Geometrical Optics (5 hrs)**

Review of mirror and thin lens formula, Combination of lenses, Chromatic aberration, Cardinal points, Monochromatic aberration and its removal, Optical fibers.

**5. Physical Optics**

**Interference (4 hrs)**

Coherent sources, double slits, thin films, Newton's rings

**Diffraction (3 hrs)**

Fraunhoffer diffraction at single slit and double slit, diffraction grating.

**Polarization (4 hrs)**

Breuester's law, Malus law, Double refraction, NIcol prism, Plane, elliptical and circular polarization, Half wave plate, Full wave plate, Optical activity and polarimeter.

**6. Electrostatics (6 hrs)**

Electric field, Gauss's Law, Electrical potential, E and V of dipole, Capacitance, Dielectrics and energy, Three electric vectors.

**7. Electricity and Magnetism**

**Current Flow (4 hrs)**

Current and current density, Resistance and resistivity, Ohm's law Energy, Combination of resistances, Kirchhoff's law network equation.

**Magnetism (7 hrs)**

Magnetic field, Magnetic force on a current, Ampere's law, Force between parallel conductor, Biot & Savart's law, Faradays law of induction, Flux linkage, Lenz's law, Self induction, Inductance, LR circuit, Energy and Energy density in Magnetic field.

**Magnetic Properties of Matter** **(2 hrs)**
Poles, Dipoles, Paramagnetism, Diamagnetism, Ferromagnetism, and three magnetic vectors.

**8. Electromagnetism (11 hrs)**
LC oscillation, Analog to SHM, Electromagnetic oscillation, Resonance, Displacement current, Maxwell's equation. Electromagnetic waves, Waves on transmission line, Waveguide, Travelling waves, Waves in free space.

**Experiments:**
1. To find out the refractive index of the liquid using convex lens by parallax method.
2. To find the refractive index of the liquid using convex lens by parallax method.
3. To determine the value of the acceleration due to gravity (in the lab) and radius of gyration using bar pendulum.
4. To find the refractive index of the material (of given prism) using a spectrometer.
5. To determine the pole strength of bar magnet by neutral point method keeping the magnet vertical.
6. To find the wavelength of sodium light by measuring the diameters of Newton's rings.
7. To determine the frequency of A.C. mains and compare the mass per unit length of two given wires.
8. To determine the wavelength of sodium light using a plane diffraction grating.
9. To determine the Velocity of Sound in air at room temperature with the first resonance air column and two tuning forks.
10. To determine the specific rotation of sugar solution using half-shade polarimeter.
11. To find the (low) resistance using Carry Foster Bridge.

**Textbooks:**
1. David Halliday and Robert Resnik, Physics I & II , H.S. Poplai for Wiley Eastern Limited, New Delhi.
2. Subrahmanyam and BrijLal, *A Text Book of Optics*, S. Chand and Company Ltd., New Delhi.

**Reference Books:**
1. H.C. Verma, *Concepts of Physics*, Bharati Bhawan (P&D)
2. J.M. Pradhan and S.K. Gupta, *Text Book of Physics*, Surya Publication, India.
3. D.N. Vasudeva, *Fundamental of Magnetism and Electricity*, S Chand and Company Ltd, New Delhi.
4. David J, Griffiths, *Introduction to Electrodynamics*, Prentice Hall of India Ltd., New Delhi.

**Lab Manual:**
1. Karki, A.B., *Physics Practical Manual*, nec Publication

**MEC 189.2 Thermal Science (2-1-2)**

**Evaluation:**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | 30 | 20 | 50 |
| Final | 50 | - | 50 |

| | | | |
|---|---|---|---|
| Total | 80 | 20 | 100 |

**Course Objectives:**

To provide working knowledge of theories and applications of thermal science.

1. To make able to apply laws of thermodynamics in various systems.
2. To make able to distinguish the cycles in various engines, and pumps.
3. To make able to calculate energy/quantity of heat transfer by conduction and radiation.

**Course Contents:**

**1. Concept and Definitions**

Thermodynamic system. Macroscopic vs. microscopic point of view. Properties and state of a substance. Processes and cycles. Specific volume. Pressure. Equality of Temperature. Zeroth law of Thermodynamics.

**2. Properties of a Pure Substance**

Vapour liquid solid phae equilibrium in a pure substance. Equations of state for a simple compressible substance. Tables and diagrams of thermodynamic properties.

**3. Work and Heat**

Definition of work. Work done in a quasi-equilibrium processes. Definition of heat. Comparison between heat and work.

**4. First Law of Thermodynamics**

First law for a cycle. First law for a process. Internal energy. Enthalpy. Specific heats. First law as a rate equation. Conservation of mass. Conservation of mass and the control volume. First law for control volume. Steady state steady flow process. Uniform state uniform flow process.

**5. Second Law of thermodynamics**

Heat Engines and Refrigerators. Second law; Reversible process; Factors causing irreversibility. Carnot cycle. Efficiency of a Carnot cycle. thermodynamic temperature scale.

**6. Entropy**

Inequality of Clausius. Entropy as a property of a system. Entropy of a pure substance. Entropy change in reversible process. Lost work. Principles of increase of entropy; Entropy change of an ideal gas. The reversible polytopic process for an ideal gas; Concepts of reversibility, Irreversibility, Availability

**7. Some Power and Refrigeration Cycles**

Vapor Power Cycles: Rankine cycle, Effect of pressure and temperature on Rankine cycle; Air Standard Cycles: Carnot cycle, Brayton cycle; Internal combustion engines: Otto cycle, Diesel cycle.

**8. Heat Transfer**

Introduction and application. Modes of heat transfer; Conduction: Fourier's law. Thermal conductivity. One-dimmensional steady state heat conduction through a plane and composite wall. Thermal resistance and conductance, Overall heat transfer coefficient. Basic laws of radiation. Black and gray bodies. Radioactive exchange between infinite parallal planes. Newton's laws. Mechanism of forced and free convention. Dimensionless Parameters: Reynld's number, Nusselt's number, Prandtl number. Simple empirical relations for plate and pipe.

**Laboratory Work:**

1. To measure the pressure, specific volume and temperature
2. To find out the efficiency of a compressor.
3. To measure the rate of heat transfer by conduction.

4. To measure performance of a small internal combustion engine
5. To measure the heat transfer by thermal radiation.
6. To measure the performance of a refrigerator / Heat pump

**Textbooks:**

1. Howell J.R. and R.O. Buckius, *Fu*
2. Bajracharya, T.R., *Fundamental of Thermodynamics and Heat Transfer*, IOE, Nepal

**Reference Books:**

1. Van Wylen, G.J. and Richard E. Sonntag, *Fundamentals of Classical Thermodynamics*, Wiley Eastern Limited, New Delhi, 1989.
3. Bayazitoglu, Y. and M. Necati Ozisik, *Elements of Heat Transfer*, McGraw-Hill Book Company, 1998.
4. Kreith, F., *Principles of Heat Transfer*, International Text book Company, Scranton Pennsylvania, 2nd Edition, I965.

**Lab Manual:**

1. Pradhan I.M., *Laboratory Manual on Thermodynamics*, **nec** Publication.

**MEC 109.1 Engineering Drawing (0-0-5)**

**Evaluation:**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | - | 100 | 100 |
| Final | - | - | - |
| Total | - | 100 | 100 |

**Course Objectives:**

1. To develop sketching, lettering and drafting skills
2. To draw projections, drawings of various geometric figures.
3. To draw assembly of machine parts.
4. To develop ability of preparing working drawings

**Course Contents:**

**1. Instrumental Drawing, Practices and Techniques (10 hrs)**

Equipment and metals, Description of drawing instruments, auxiliary equipment and drawing materials, Techniques of instrument drawing, pencil sharpening, securing paper, proper use of T-squares, triangles, scales, dividers, compasses, erasing shields, French curves, inking pens.

**Freehand Technical Lettering**

Lettering strokes, letter proportions, use of pencils and pens, uniformity and appearance of letters, freehand techniques, inclined and vertical letters and numerals, upper and lower cases, standard English lettering forms.

**Dimensioning**

Fundamentals and Techniques: size and location dimensioning, IS conversion; Use of scales, measurement units, reducing and enlarging drawings; General dimensioning practices: placement of dimensions aligned and unidirectional recommended practice, some 50 items.

**2. Applied Geometry (20 hrs)**

Plane geometrical construction: Bisecting and trisecting lines and angles, proportional division of lines, construction of angles, triangles, squares, polygons, constructions using tangents and circular archs. Methods of drawing standard curves such as ellipse, parabolas, hyperbolas, involutes, spirals, cycloid and helices (cylindrical and helical); Solid geometrical construction: Classification and pictorial representation of solid regular objects such as: prisms, square, cubical, triangular and oblique, Cylinders: right and oblique, Cones: right and oblique, Pyramids: square, triangular, oblique, truncated; Doubly-curved and warped surfaces: Sphere, torus, oblate ellipsoid, conoid, serpentine, paraboloid, hyperboloid.

**Basic Descriptive Geometry**

Introduction: Application of descriptive geometry principles to the solution of problems involving positioning of objects in three-dimensional space; The projection of points, and planes in space; Parallel lines; True length of lines: horizontal, inclined and oblique lines; Perpendicular lines; Bearing of a line; Point view of end view of a line; Shortest distance from a point to a line; Principal lines of a plane; Edge view of a plane; True shape of an oblique plane;

Intersection of a line and plane; Angle between a line and a plane; Angle between two non-intersecting (skew) lines; Dihedral angle between two planes; Shortest distance between two skew lines.

**3. Theory of Projection Drawing (25 hrs)**

Perspective projection drawing; Orthographic projection; Axonometric projection; Oblique projection; First and third angle projection; Oblique projection; First and third angle projection; Oblique projection' First and third angle projection; Systems and projection.

**Multi-view Drawings**

Principal views: Methods for obtaining orthographic views: Projection of lines, angles and plane surfaces, analysis in three views; Projection of curved lines and surfaces; Object orientation and selection of views for best representation; Full and hidden lines. Orthographic drawings: Making an orthographic drawing, Visualizing objects from the given views; Interpolation of adjacent areas; True-length lines; Representation of holes; conventional practices.

**Sectional views**

Full section view; Half section; Broken section; Revolved section; Removed (detail) sections; Phantom of hidden section; Auxiliary sectional views; Specifying cutting planes for sections; conventions for hidden lines, holes, ribs, spokes.

**Auxiliary Views**

Basic concept and use of auxiliary views; Drawing methods and types of auxiliary views; Symmetrical and unilateral auxiliary views; Projection of curved lines and boundaries; Line of intersection between two planes; True size of dihedral angles; True size and shape of plane surfaces.

**4. Development and Intersections (10 hrs)**

Development: General concepts and practical considerations, Development of a right or oblique prism, cylinder, pyramid and cone; Development of truncated pyramid and cone; Triangulation method for approximately developed surfaces; Transition pieces for connecting different shapes; Development of a sphere; Intersections: Lines of intersection of geometric surfaces; Piercing point of a line and a geometric solid; intersection lines of two planes; Intersection of prisms and pyramids; Intersection of a cylinder and an oblique plane; Intersection of a sphere and an oblique plane; Constructing a development using auxiliary views; Intersection of two cylinders; Intersection of a cylinder and cone.

**5. Machine Drawing (10 hrs)**

Introduction: production of complete design and assembly drawings; Fundamental techniques: size and location dimensioning; placement of dimension lines and general procedures; standard dimensioning practice (IS system); Limit dimensioning: nominal and basic size, allowance, tolerance, limits of size, clearance fit, interference fit; basic hole system and shaft systems; Thread and standard machine assembly elements: screw threads: ISO standards, representation and dimensioning; Fasteners: type and drawing representation, keys, collars, joints, springs bearings; Assembly drawings: drawing layout, bill of materials, drawing layout, bill of materials, drawing numbers.

**Laboratory Work:**
Freehand technical lettering and use of drawing instruments; Dimensioning; Geometrical and Projection drawing; Descriptive geometry; Projection and multiview drawings; Sectional views; Auxiliary views, Freehand sketching and visualization; Development and intersections; machine and assembly drawings.

**Reference Books:**
1. Luzadder, *Fundamentals of Engineering Drawing*, Prentice Hall of India Ltd., 8th edition, 1981.
2. French, C.J. Vierck and R.J. Foster, *Engineering Drawing and Graphic Technology*, McGraw-Hill, 1981.

**CMP 103.3 Programming in C (3-0-3)**

**Evaluation:**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | 30 | 20 | 50 |
| Final | 50 | - | 50 |
| Total | 80 | 20 | 100 |

**Course Objectives:**
The object of this course is to acquaint the students with the basic principles of programming and development of software systems. It encompasses the use of programming systems to achieve specified goals, identification of useful programming abstractions or paradigms, the development of formal models of programs, the formalization of programming language semantics, the specification of program, the verification of programs, etc. the thrust is to identify and clarify concepts that apply in many programming contexts:

**Course Contents:**

**1. Introduction (4 hrs)**
History of computing and computers, Text editing and file concepts, Traditional and structured programming concept, Problems analysis, flow chart and algorithm, Program Documentation

**2. Variables and data types (3 hrs)**
Constants and variables, Variable declaration, Variable Types, Simple input/output function, Operators

**3. Loops and Decisions (5 hrs)**
Introduction, For Loop, While Loop, Do while Loop, Nested Loop, Case, break and continue statements, The if, if else, else-if and switch statements.

**4. Functions (6 hrs)**

Introduction, Returning a value from a function, Sending a value to a function, Arguments, External variables, Preprocessor directives, C libraries, Macros, Header files and prototyping

**5. Arrays and Strings (9 hrs)**

Introduction to Arrays, Initializing Arrays, Multidimensional Arrays, String, Functions related to the strings, Function related to Graphics

**6. Pointers (10 hrs)**

**7.**

Pointers definition, Pointers and Arrays, Returning multiple values from functions, using pointers, Pointer Arithmetic, Pointer and Strings, Double Indirection, Pointer to Arrays

**8. Structure and Unions (5 hrs)**

Definition of Structure, Nested type Structure, Arrays of Structure, Structure and Pointers, Unions

**9. Files and File Handling (3 hrs)**

Operating a file in different modes (Real, Write, Append), Creating a file in different modes (Read, Write, Append)

**Laboratory:**

Laboratory work at an initial stage will emphasize on the verification of programming concepts learned in class and use of loops, functions, pointers, structures and unions. Final project of 10 credit hours will be assigned to the students which will help students to put together most of the programming concepts developed in earlier exercises.

**Textbooks:**

1. A book on C by A1 Kely and Ira Pohl
2. The C Programming Language by Kerighan, Brain and Dennis Ritchie

**ELE 105.3 Basic Electrical Engineering (3-1-2)**

**Evaluation:**

| | Theory | Practical | Total |
|---|---|---|---|
| Sessional | 30 | 20 | 50 |
| Final | 50 | - | 50 |
| Total | 80 | 20 | 100 |

**Course Objectives:**

1. To analyze electric circuits (A.C. & D. C).
2. To work on electrical instrumentation projects.
3. To operate, distinguish and use electrical devices and machines.

**Course Contents:**

**1. Network Theory**

Circuit concepts (lumped and distributed parameters, Linear and non-linear parameters, passive and active circuits), Circuit elements (RLC) and their characteristics, Star-delta transformation, Ideal and non-ideal sources, Dependent and independent sources, Kirchhoff's current and voltage laws, Voltage divider and current divider formula. Nodal Method and Mesh method of network analysis, Network theorems (Thevenin's Norton's, Superposition, Maximum power transfer)

**2. AC Circuit Analysis**

Generation of alternating voltage Sinusoidal Functions- terminology, Average value and RMS or effective value of any type of alternating voltage or current waveform, Phasor algebra, Steady state response of circuits concept of Admittance, Reactance, Instantaneous power, Average real-power, Reactive power, Power factor and significance of power factor, Resonance in series and parallel RLC circuits, Bandwidth, Effect of Q-factor in resonance, Concept of a balanced three phase supply, Advantages of 3-phase system, Star & delta connected supply and load circuits, Line and Phase voltages/ current relations, Concept of three phase power and its measurement by two wattmeter method.

**3. Basic Instrumentation**

Classification and basic requirements. Moving iron, Moving coil and induction type ammeters and voltmeters, Dynamometers, single phase energy meter

**4. Devices and Machines**

Magnetic circuits, Analogy with electric circuits, Calculations of magnetic circuits, Hysteresis and eddy-current effects in ferromagnetic materials.

Single phase transformers, Principle of Operation, Constructional features, Equivalent circuit and phasor diagram, Efficiency and regulation, Testing of transformers (O.C. and S.C. tests).

Electromechanical energy-conversion principles, Construction features of rotating electric machines, Generation of emf and torque, Elementary principles of three phase synchronous generator.

D.C. Machines, Performance and operation, types of excitation, brief explanation of armature reaction and communication, Characteristics of motors and generators, Starting, Speed control and selection of motors.

Three phase induction motors, Principle of operation, Characteristics starting and speed control, Introduction to single phase induction motor.

**Laboratory Work:**

1. To measure current, voltage and power across the passive components.
2. To verify Kirchhoff's Current Law (KCL) & Kirchhoff's Voltage Law (KVL)
3. To verify Thevenin's Theorem.
4. To verify maximum power transfer theorem.
5. To verify superposition theorem.
6. To measure three phase power by using two wattmeter.
7. To determine efficiency and voltage regulation of a single-phase transformer by direct loading.
8. To study open circuits & short circuits tests on a single phase transformer.
9. To study the speed control of dc shunt motor by.
   i. Varying the field current with armature voltage held constant field control.
   ii. Varying the armature voltage with field current held constant armature control.
10. To study open circuits and load test on a dc shunt generator (separately excited)
    i. To determine magnetization characteristics

ii. To determine V-I characteristics of a dc shunt generator.

**Textbook:**

1. S.N. Tiwari and A.S. Gin Saroor, *A First Course in Electrical Engineering*, A. H. Wheeler and Co. Ltd., Allahabad, India

**Reference Books:**

B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology*, S. Chand and Company Ltd., New Delhi, India.
V. Del Toro, *Principles of Electrical Engineering*, Prentice Hall of India, Ltd. New Delhi.
I.J. Nagrath, *Basic Electrical Engineering*, Tata McGraw Hill, New Delhi.
P.S. Bhimbra, *Electric Machinery*, Khanna Publishers, New Delhi.