CALCULUS & ANALYTICAL GEOMETRY (GSM-111)

Contact Hours:
Theory = 48
Practical = 0
Total = 48

Credit Hours:
Theory =3**.0**
Practical = **0.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Comprehend** key concepts of single variable calculus, differential calculus, integral, multivariate calculus, and analytical geometry.	Cognitive	2	1
2	**Apply** the fundamentals of functions, limits and continuity, derivative, integration, Partial differentiation to engineering problems.	Cognitive	3	2
3	**Solve** problems of analytical geometry using rectangular co-ordinates systems in 3 dimensions.	Cognitive	3	2

COURSE CONTENTS:

Single Variable Calculus:
Basic concept of single variable function, Continuous, discontinuous and piecewise continuous functions, Periodic, odd and even functions, algebraic functions, Applications of functions in our daily life situations.

Differential Calculus:
Limits and continuity, Interpretation of a derivative, Geometric interpretation, Total differential and its applications in our daily life situations, The use of a table of different type derivatives, Higher order derivatives, Point of inflexion and its applications in business and engineering.

Integral Calculus:

Basic concepts of integration, some rules of integration, Definite integrals, The area bounded by a curve, Integration by parts, Volume of revolution, and its applications in our daily life situations.

Multivariate Calculus:
Basic concepts of multivariate function, Level curves and surfaces, Limits and continuity, Partial differentiation, Geometric interpretation, higher partial derivatives. Tangent planes, Total differential.

Analytical solid geometry:
Rectangular co-ordinates systems in three dimensions. Directions cosines, Plane (straight line) and sphere.

RECOMMENDED BOOKS:

1. George B. Thomas, Jr., "*Thomas' Calculus",* 13th Edition. Pearson, USA.
2. G.B. Thomas, R.L. Finny, "Calculus and Analytic Geometry", 9th Edition, 1995, Addison Wesley.
3. Robert T. Smith, Roland B. Minton, *Multivariate Calculus,* McGraw-Hill 2003.
4. R Ellis, D Gulick, *Calculus: One and Several Variables,* Saunders College Pub, 1991.
5. Tony Croft, Robert Davison, *Mathematics for Engineers,* Pearson Education Limited 2015.
6. W Kaplan, *Advanced Calculus,* 5th Edition, Addison-Wesley, 2002.

APPLIED PHYSICS (GSM-112)

Contact Hours:
Theory =16
Practical = 48
Total = 64

Credit Hours:
Theory =1**.0**
Practical = **1.0**
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**Comprehend** key concepts related to position, velocity and acceleration in Cartesian Coordinate System.	Cognitive	2	1
3	**Apply** the key concepts of electrostatic force/field/potential, electricity and magnetism.	Cognitive	3	2
4	**Analyze** the problems of electromagnetics using different principles and techniques for their solution	Cognitive	4	2
5	**Conduct** experiments in mechanics, oscillations and electromagnetism.	Psychomotor	3	4

COURSE OUTLINE

1. Measurement of Physical Quantities
2. Introduction to Mechanics
    a. Rectilinear Motion
    b. Vectors
    c. Motion in 2 and 3 Dimension
    d. Force and Motion
3. Kinetic Energy and Work
4. Coulomb's Law
5. Electric and Magnetic Fields
6. Gauss's Law

Practical Work

Experiments related to concepts learned in theory classes will be conducted.

Teaching Methodology

- Lecturing
- Problem Solving Sessions (Tutorial, Interactive)
- Written Assignments
- Practical Experiments for Lab Work

Assessment

Quizzes, Assignments, Mid Exam, Final Exam

TEXTBOOK AND REFERENCE BOOKS(Latest Edition)

1. Fundamentals of Physics. Halliday, Resnick and Walker, *Fundamentals of Physics*, John Wiley & Sons
2. Houg D. Young and Roger A. Freedman, *University Physics*, Addison-Weslay
3. Raymond A. Serway, John W. Jewett,Jr. *Physics for Scientists and Engineers with Modern Physics.*
4. Halliday, Rsenick, *Principles of Physics, International Student Version*
5. Paul A. Tipler, GeneMosca, *Physics for Scientists and Engineers with Modern Physics*

APPLIED CHEMISTRY (GSM-113)

Contact Hours:
Theory = 32
Practical = 0
Total = 32

Credit Hours:
Theory = **2.0**
Practical = 0.0
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Demonstrate** knowledge of applied chemistry and its application to mechanical engineering.	Cognitive	3	1
2.	**Identify** chemical compounds with harmful effects on environment and propose their control.	Cognitive	1	7
3.	**Solve** engineering problems of chemical nature in field of mechanical engineering.	Cognitive	3	1

COURSE OUTLINE:

- **Physical Chemistry**: Properties of various groups and periods of periodic table.
- **Atomic Structure and Interatomic bonding**: Atomic structure, atomic bonding and mechanical bonding. Polymorphism and allotropic forms. Crystallography basics.
- **Basic Mechanical properties**: Structure of metals and ceramics.
- **Thermo-chemistry**: Chemical Thermodynamics, Hess's Law, heat of Formation and reaction, relation between H and U, measurement of heat reaction, Bomb calorimeter
- **Electrochemistry**: Laws of electrolysis
- **Industrial Chemistry**: Industrial chemistry introduction, manufacturing and uses of various hydrocarbons. Lubricants and oils. Production and application of paints, vulcanized rubber and fuels. Environmental pollution and control.
- **Water Treatment Methods**: Water softening, treatment of water for industrial purposes.

Teaching Methodology

- Lecturing
- Written Assignments
- Field Visits
- Report Writing

Assessment

Mid Term, Presentation, Assignments, Quizzes, Report Writing, Final Term

TEXT AND REFERENCE BOOKS(Latest Edition)::

1. W. H. Brown and L. S. Brown, *Chemistry for Engineering Students*, Cengage Learning.
2. O. V. Roussak, H. D. Gesser, *Applied Chemistry: A Textbook for Engineers and Technologists:* Springer.
3. S. S. Zumdahl, *Chemistry: An Atoms First Approach*, Cengage.
4. N. J. Tro, Chemistry: *A Molecular Approach*, Pearson.
5. M. J. Shultz, *Engineering Chemistry*, Cengage.
6. A. Bahl, B. S. Bahl, G. D. Tuli, *Essential of Physical Chemistry*, S. Chand Publishing, India.

FUNCTIONAL ENGLISH (HSM-114)

Contact Hours:
Theory = 32
Practical = 0
Total = 32

Credit Hours:
Theory = **2.0**
Practical = 0.0
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Demonstrate** basics of grammar, parts of speech and use of articles through verbal and non-verbal means.	Cognitive	3	10
2.	**Analyze** the given statement for phrases, clause and sentence structure.	Cognitive	4	10

COURSE OUTLINE:

1. **Functional English.**
    a. Basics of Grammar
    b. Parts of speech and use of articles
    c. Sentence structure
    d. Active and passive voice
    e. Practice in unified sentence
    f. Analysis of phrase
    g. Clause and sentence structure
    h. Transitive and intransitive verbs
    i. Punctuation and spelling
2. **Comprehension**
    a. Answers to questions on a given text
3. **Discussion**
    a. General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)
4. **Listening**
    a. To be improved by showing documentaries/films carefully selected by subject teachers)
5. **Translation skills**

a. Urdu to English

6. **Paragraph writing**
    a. Topics to be chosen at the discretion of the teacher
7. **Presentation skills**
    a. Introduction
    b. Extensive reading is required for vocabulary building

RECOMMENDED BOOKS:

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 1. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises 2. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brain Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19453402 2.

COMPUTER SYSTEM & PROGRAMMING (CSM-115)

Contact Hours:
Theory = 32
Practical = 48
Total = 80

Credit Hours:
Theory = **2.0**
Practical = 1.0
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Comprehend** fundamental programming concepts such as variables, functions, arrays, if-else, file handling, loops.	Cognitive	2	1
2.	**Solve** problems using computer programs.	Cognitive	3	5

COURSE OUTLINE(THEORY):

Fundamentals of computer hardware and software; introduction to programming in C; data types; input and output operators; arithmetic operators; operator precedence; relational operators; conditional statements (if, if-else, and switch statements); loop statements (for, while, do-while statements); pointers; file handling and structures.
Word Processing, Spread-sheets, Presentation software, Internet Browsers & E-mail.
Flowcharts, Pseudo codes, logical gates.

COURSE OUTLINE(LAB):

Programming in C++.Structural Programming, logical and mathematical operators, loops, conditional statements, arrays, functions. Introduction to Matlab and implementation of the loops in Matlab.

RECOMMENDED BOOKS(Latest Edition)::

1. R Lafore, *Waite Group's Turbo C Programming for the PC*, Revised ed, Sams Pub.
2. B S Gottfried, *Schaum's Outline of Programming with C*, McGraw Hill.
3. C++ How to Program, Harvey M. Deitel, Paul J. Deitel, Prentice Hall.
4. Object-Oriented Programming in C++, Robert Lafore, Fourth Edition, Sams Publishers.

ENGINEERING DRAWING & GRAPHICS (BME-116)

Contact Hours:
Theory =16
Practical = 48
Total = 64

Credit Hours:
Theory = **1.0**
Practical = 1.0
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**ACQUIRE** the basic knowledge of drawing skills.	Cognitive	2	1
2.	**APPLY** the concepts of mechanical engineering drawing techniques.	Cognitive	3	2
3.	**DEMONSTRATE** individually the drawings of plan, elevation and cross sections of machine parts	Cognitive	3	1

COURSE OUTLINE:

Engineering Graphics (Theory)

1. **Orthographic Projection**

Principle and Methods of projection, Orthographic projection, Planes of projection, First and Third-angle projection, Reference line

2. **Projection of Points**

A point is situated in the first, second, third and fourth quadrant

3. **Projection of Straight Lines**

Line parallel and perpendicular to one or both the planes, Line contained by one or both the planes, Projections of lines inclined to both the planes, True length of a straight line and its inclinations, Methods of determining traces of a line

4. **Projection of Planes (2D)**

Types and Traces of planes, Projections of planes, Projections of oblique planes

5. **Projections on Auxiliary Planes (2D)**

Types of auxiliary planes and views, Projection of a point on an auxiliary plane, Projections of lines and planes

6. **Projections of Solids (3D)**

Types of solids and their projections, Projections of solids with axes inclined

7. **Section of Solids (3D)**

Section of planes, prisms, pyramids, cylinders, cones, spheres, Methods of development, Triangulation development, Developments of lateral surfaces of right solids

8. **Isometric Projections (3D)**

Isometric axes, lines, planes, and scale, Isometric drawing or isometric view, Isometric drawing of planes or plane figures, prisms and pyramids, cylinders, cones and sphere

Engineering Drawing (Lab):

1. **Introduction**

   Introduction to Engineering Drawing, I. S. specification for preparation of drawings, Use of drawing instruments and materials, Basic Tools, Lines: Types, configuration and application, Selection of line thickness,

2. **Lettering, Numbering and Dimensioning**

   Vertical and inclined single stroke letters, Lettering types and rules, Dimension lines, projection lines, leaders or pointer lines, Arrow heads, Dimensioning,

3. **Geometric Construction**

   Drawing simple geometric objects (polygon, pentagon and hexagons etc).

4. **Orthographic Projections of different Solids**

   I-beam etc.

5. **Orthographic Projections of Machine Elements**

   Rivets, Nut and bolts, Different kinds of threads, Lap and butt joints, Flange couplings, Journal bearing, Open bearing, Footstep bearing, Crankshaft, Bearings

Course Content(Lab):

Select a machine, study its operation and machine elements detail.

Draw the 3D model of the machine and draw 2D drawings. Apply the real mechanism to the machine.

Teaching Methodology

Lecturing , Assignments, Drafting.

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books(Latest Edition):

1. N.D Bhatt, *Engineering Drawing and Graphics*
2. B. Wiebe, M. Mohler ,*Technical Graphics Communication*, McGraw-Hill
3. Abbot, *Practical Geometry & Engineering Graphics*
4. Craft, Meyers & Boyer, *Engineering Graphics*
5. G. R. Bertoline, E. N. Wiebe, *Technical Graphics Communication*; McGraw-Hill
6. D.F. Rogers, J.A. Adams; *Mathematical Elements for Computer Graphics*, McGraw-Hill
7. A. C Parkinson, A First Year Engineering Drawing

ENGINEERING MECHANICS-I: STATICS (BME-117)

Contact Hours:
Theory =48
Practical = 00
Total = 48

Credit Hours:
Theory =**3.0**
Practical = **0.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Taxonomy Level	PLO
1	**COMPREHEND** concepts of vectors, scalars, forces, moments and couples.	Cognitive	2	1
2	**APPLY** the learned concepts of mechanics to solve problems of equilibrium in 2-D, 3-D including problems of friction.	Cognitive	3	2
3	**SOLVE** problems related to mechanical structures such as plain trusses, frames and machines.	Cognitive	3	2

COURSE OUTLINE:

1. **Introduction to subject**
2. **Force System**
    a. Introduction to Force System
    b. Rectangular components, Moment, Couple and Resultants (Two dimensional Force systems)
3. **Equilibrium**
    a. Mechanical system isolation and Equilibrium condition in two dimensions
    b. Equilibrium Conditions-Equilibrium in three Dimensions
4. **Structures**
    a. Plane Trusses
    b. Method of joints
    c. Method of Sections and Space Trusses
    d. Frames and Machines
5. **Friction**
    a. Types of Friction

Teaching Methodology

- Lecturing

- Problem Solving Sessions
    - Tutorial
    - Interactive
- Written Assignments

Assessment

Quizzes, Assignments, Mid Exam, Final Exam

TEXT AND REFERENCE BOOKS:

1. J L Meriam, L G Kraig, *Engineering Mechanics (Statics)*: John Wiley & Sons Inc.
2. Beer & Johnston, *Vector Mechanics for Engineers: Statics & Dynamics*, McGraw Hill
3. RC Hibbeler, *Engineering Mechanics (Statics)*, Prentice Hall
4. Anthony M Bedford, Wallace Fowler. *Engineering Mechanics (Statics)*, Prentice Hall
5. E. Nelson, *Engineering Mechanics: Statics*, Schaum's outline series New York.

INTRODUCTION TO CHINESE LANGUAGE (BME-118)

Contact Hours:
Theory =0.0
Practical =0.0
Total = 00

Credit Hours:
Theory =0**.0**
Practical = **0.0**
Total = 0**.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**DISTINGUISH** main ideas and employ active reading strategies to understand text.	Cognitive	3	10
2.	**CONSTRUCT** clear and grammatically correct sentences using a variety of sentence structures and appropriate vocabulary.	Cognitive	3	10
3.	**ORGANIZE** ideas in paragraphs and essays with clarity.	Cognitive	3	10

COURSE OUTLINE:

Basics of Grammar, Parts of speech and use of articles, Sentence structure, clause and sentence structure, Punctuation and spelling.
Comprehension: Answers to questions on a given text
Discussion: General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)
Listening: To be improved by showing documentaries/films carefully selected by subject teachers)
Translation skills: English to Chinese
Paragraph writing: Topics to be chosen at the discretion of the teacher
Note: Extensive reading is required for vocabulary building

RECOMMENDED BOOKS:

1. Hanyu Kouyu Elementary spoken Chinese (Dai Guifu Liu Lixin Li Halyan)
2. Hanyu Jiaocheng (Beijing Language and Culture University)
3. Experiencing Chinese Elementary listening Chinese
4. Developing Chinese (Beijing Language and Culture University

COMPUTER AIDED DRAWING (CAD) (BME-121)

Contact Hours:
Theory = 0
Practical = 48
Total = 48

Credit Hours:
Theory = 0.0
Practical = 1.0
Total = **1.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**ACQUIRE** the basic knowledge of CAD tools.	Cognitive	1	1
2.	**Analyze** multi-views of an object using computer tools.	Cognitive	4	5
3.	**DEMONSTRATE** the 3D modelling of the machine elements.	Cognitive	3	5

COURSE OUTLINE:

1. Introduction to CAD
2. 2D Drafting
3. 3D Modeling of Machine Elements (Part and Assembly)
4. Mechanisms and assembly

Practical:

- Select a machine and study its operation and machine elements detail.
- Draw the 3D model of the machine element and draw 2D drawings.
- Introduction and basics of Pro-Engineer.

Teaching Methodology

- Lecturing
- Assignments
- Design Project

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS(Latest Edition):

1. R. Lal, R. Rana, *A Textbook of Engineering Drawing: Along with an Introduction to AutoCAD.*
2. T. Jeyapoovan, *Engineering Drawing and Graphics Using AutoCAD.*
3. Z. A. Siddiqui, M. Ashraf and S. A. Siddiqui. *Basics of Engineering Drawing*
4. D. A. Jolhe, *Engineering Drawing with an introduction to AutoCAD*

ENGINEERING MATERIALS (BME-122)

Contact Hours:
Theory =48
Practical = 00
Total = 48

Credit Hours:
Theory =**3.0**
Practical = **0.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Level	PLO
1	**Explain** and give examples of different types of engineering materials based on bonding, crystal structure & mechanical properties.	Cognitive	2	1
2	**Apply** the knowledge obtained from phase diagrams, SAE & ASTM designations and microscopic techniques for investigating the microstructure..	Cognitive	3	2
3	**Differentiate** between the properties of interest in metals, polymers, ceramics and composites and their implication in terms of environment and sustainability.	Cognitive	4	7

COURSE OUTLINE

1. Introduction to Materials Science and Engineering
2. Atomic Bonding
3. Structure of Crystalline Solids
4. Imperfections in Solids
5. Phase Diagrams
6. Phase Transformation and Development of Microstructures
7. Applications and Processing of Metallic Materials
8. Structure, Properties and Applications of Polymer Materials
9. Composite Materials
10. Corrosion and degradation of Materials

Teaching Methodology

- Lecturing
- Written Assignments

Assessment

Quizzes, Assignments, Mid Exam, Final Exam

TEXT AND REFERENCE BOOKS(Latest Edition):

1. J. T. Black , Ronald A. Kohser, *DeGarmo's Materials and Processes in Manufacturing*, Wiley
2. W D Callister, *Fundamentals of Materials Science*, 7th ed, John Wiley, 2007
3. M F Ashby, H Shercliff, D Cebon, *Materials Engineering, Science, Processing and Design*, Butterworth-Heinemann, 2007
4. M F Ashby, *Materials Selection in Mechanical design*, 4th ed, Butterworth-Heinemann, 2011

LINEAR ALGEBRA & ORDINARY DIFFERENTIAL EQUATIONS (GSM-123)

Contact Hours:
Theory = 48
Practical = 0
Total = 48

Credit Hours:
Theory = **3.0**
Practical = 0.0
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**State** the basic formulas of linear algebra, differentiation and integration.	Cognitive	1	1
2	**Demonstrate** concepts of matrices, determinant, linear transformations, linear systems, vector spaces and solution of ODEs.	Cognitive	3	2

COURSE OUTLINE

Vector Algebra:
Introduction to scalars and vectors, Vectors in the plane, Scalar and vector products, Lines in R2, R3and planes, Spheres, Orthogonal projections, Perpendicular distance from a point to a line and plane, Vector spaces, Subspaces, Linear combinations, Linearly dependent and Independent set of vectors, Spanning of a vector spaces, Bases of a vector spaces and its applications in engineering and Business.

Matrix Algebra:
Introduction to matrices, Matrix operations, Inverse Matrix, Rank of a Matrix, Echelon form of a Matrix and its applications in our daily life situation problems, i.e. in line communication as Air-lines, Telephone-lines, Connecting cities by roads.

Determinants:
Determinants and its properties, Inverse of a matrix, Rank of a matrix, Linearly dependent and independent by determinants.

Linear System of Equations:
Independent, Dependent and Inconsistent system of equations and its graphical representation, Trivial and non-trivial solutions of homogeneous system of linear equations and its applications as linear models in Business, Economics, Science, Electric Circuits and other branches of engineering. Solution of linear system of equations by determinants and its applications as Leontief input-output matrix of the economy, Coding and decoding theory.

Linear Transformations:
Reflection operators, Projection operators, Rotation operators, Shear in x and y directions, Dilation and Contraction.

Ordinary Differential Equations:
Basic concepts of ordinary differential equation, General and particular solutions, Initial and boundary conditions, Linear and nonlinear differential equations, Solution of first order differential equation by separable variables and its applications in our daily life situations, The techniques like change of variable, homogeneous, nonhomogeneous, exact, non-exact, linear and nonlinear Bernoulli could be used in case of complications. Solution of second order differential equation by theory of operators and its applications as forced and free oscillations, The extension of second order solution criteria to higher order differential equations, Solution of the system of differential equations by theory of operators and its applications in our daily life situations, Laplace solution of ordinary differential equations.

RECOMMENDED BOOKS:

1. David C. Lay, *Linear Algebra and its Applications*, 4th Edition, Pearson, Cambridge, 2011. (if 4th is not available then 2nd Edition).
2. Abell and Braselton, *Modern Differential Equations*, 2nd Edition, Harcourt College Publishers, 2001
3. Louis C. Barrett, *Advanced Engineering Mathematics*, 6th Edition, McGraw Hill International Edition.
4. E. A. Coddington and N. Levinson, *Theory of Ordinary Differential Equations*, Mc-Graw Hill, New York, Toronto and London, 1955.
5. W. E. Boyce and R. de Prima, *Elementary Differential Equations*, 9th Edition, Wiley, 2008.
6. V. I. Arnold and R. Cooke, *Ordinary Differential Equations*, 2006 Edition, Springer, 2006.
7. M. R. Boelkins, L. G. Jack, M. C. Potter, *Differential Equations with Linear Algebra*, Oxford University Press, 2009.
8. C. H. Edwards, D. E. Penney, *Elementary Differential Equations*, 6th Edition, Pearson Prentice Hall, New Jersey, 2007.

ENGINEERING MECHANICS-II: DYNAMICS (BME-124)

Contact Hours:
Theory =48
Practical = 48
Total = 96

Credit Hours:
Theory =**3.0**
Practical = **1.0**
Total = **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Comprehend** key concepts related to kinematics and kinetics of particles in different coordinate systems.	Cognitive	2	1
2	**Solve** problems related to kinematics and kinetics of particles and rigid bodies under translation / rotation / general plane motion.	Cognitive	3	2
3	**Measure** various parameters related to motion using different experimental setups.	Psychomotor	4	2

COURSE OUTLINE (Theory)

1. Introduction to subject and Basic Concepts
2. **Kinematics of Particles**
    a. Rectilinear Motion
    b. Plane Curvilinear Motion
    c. Space Curvilinear Motion
    d. Motion Relative to Trans Axes
    e. Constrained Motion of Connected Particles
3. **Kinetics of Particles**
    a. Second Law & Equation of Motion
    b. Work and Energy
    c. Linear Impulse and Momentum
    d. Impact
    e. Angular Momentum
4. **Kinematics of Rigid Bodies**
    a. Plane Motion
    b. Relative Velocity
    c. Relative Acceleration

5. **Kinetics of Rigid Bodies**
    a. Kinetics of Rigid Bodies

Teaching Methodology

- Lecturing
- Problem Solving Sessions
    - Tutorial
    - Interactive
- Written Assignments

Assessment

Quizzes, Assignments, Mid Exam, Final Exam

TEXTBOOK AND REFERENCE BOOKS(Latest Edition):

1. J L Meriam, L G Kraig. *Engineering Mechanics (Dynamics)*: John Wiley & Sons Inc.
2. Beer & Johnston. *Vector Mechanics for Engineers: Statics & Dynamics*, McGraw Hill
3. RC Hibbeler. *Engineering Mechanics (Dynamics)*.
4. Anthony M Bedford, Wallace Fowler. *Engineering Mechanics (Dynamics)*, Prentice Hall
5. E. Nelson, *Engineering Mechanics: Statics*, Schaum's outline series New York.

COURSE OUTLINE (Lab)

- Basic understanding of various engineering structures in equilibrium.
- Knowledge regarding physical phenomena in mathematical terms.
- Fundamental concepts of bodies under static & dynamic conditions
- Laws of motions to components / structures under the influence of forces

Reference Books:

- Lab Manuals

WORKSHOP PRACTICE (BME-125)

Contact Hours:
Theory =0
Practical = 96
Total = 96

Credit Hours:
Theory = **0.0**
Practical = 2.0
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Taxonomy Level	PLO
1	**Describe** the basic workshop tools and practices.	Cognitive	2	1
2	**Imitate** Skills for making various simple parts using basic manufacturing tools.	Psychomotor	3	1
3	**Assume responsibility** regarding the safety of oneself and others.	Affective	3	9

COURSE OUTLINE:

Fitter Shop: Assembly/disassembly of basic mechanical components, e.g. bearings, keys, belts, etc. Basic Processes in **Wood Work Shop**: Timber, its defects and preservation methods, different types of wood joints. Basics of **Electric Shop**: Types and uses of cables. Study of household electrical appliances. Functions of Forge & **Foundry Shop**: Brief introduction, tools and accessories, furnace types, heat treatment furnaces. Carbon dioxide casting. **Machine Shop**: Introduction to machine tools, basic lathe operations including turning, facing, screw cutting. **Welding**: Introduction to soldering, brazing and welding, brief details of gas, and electric arc welding.

Teaching Methodology

- Demonstration
- Lab Report Writing

Assessment

Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

TEXT AND REFERENCE BOOKS(Latest Edition):

1. Lab Manual
2. W A J Chapman, Workshop Technology Part-I, Butterworth-Heinemann.
3. H P Schwan, Electrical Wiring, McGraw Hill.

4. Wiring Manual, Pak Cables Limited. ME-201 ENGINEER

ARABIC (ISM-126)

Contact Hours:		**Credit Hours:**	
Theory	= 32	Theory	= **2.0**
Practical	= 0	Practical	= 0**.0**
Total	= 32	Total	= 2**.0**

Specific Objectives of course:

- To enables students to understand the Arabic language and literature

COURSE OUTLINE:

Translation:

Arabic into Urdu.
Urdu into Arabic.

RECOMMENDED BOOKS:

1. Al Listan-ul-Arabi by Nouman Muhammd Tashkandi
2. Tehsil-ur-Surf by Hafiz Khan Muhammad Noori
3. Tehsil-ul-Nahv by Hafiz Khan Muhammad Noori

THERMODYNAMICS-I (BME-127)

Contact Hours:
Theory = 48
Practical = 0
Total = 48

Credit Hours:
Theory = **3.0**
Practical = 0.0
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Understand** the nature and role of the thermodynamic properties of matter and processes on appropriate diagrams.	Cognitive	2	1
2.	**Apply** energy and entropy balances to the closed and open systems.	Cognitive	3	2
3.	**Analyze** implications and limitations of Thermodynamics in environmental context.	Cognitive	4	7

COURSE OUTLINE:

1. **Introduction and Basic Concepts**
   a. First law of thermodynamics and its applications
   b. System and boundary
   c. Specific volume, pressure and temperature

2. **Energy, Energy Transfer, and General Energy Analysis**

   a. Equilibrium state, processes
   b. Methods to solve thermodynamics problems

3. **Properties of Pure Substances**

   a. Phase change processes, P-v-T relation
   b. Property diagrams
   c. Equation of state, specific heats
   d. Compressibility polytropic process relation.

4. **Energy Analysis of Closed Systems**

a. Energy balance of closed system

5. **Mass and Energy Analysis of Control Volumes**

    a. Energy analysis of power, refrigeration and heat pump cycles

6. **The Second Law of Thermodynamics**

    a. Spontaneous and non-spontaneous processes
    b. Thermodynamic cycles, irreversible and reversible process, and Carnot cycle
    c. Clausius inequality.

7. **Entropy**
    a. Entropy change, T-s diagram, entropy generation
    b. Increase of entropy principle, entropy rate balance of closed systems and control volumes
    c. Isentropic efficiencies

Teaching Methodology

- Lecturing
- Written Assignments

Assessment

Mid Exam, Final Exam, Assignments, Quizzes, Computational assignments

TEXT AND REFERENCE BOOKS(Latest Edition):

1.Yunus A. Cengel, Michael A., *Thermodynamics: An Engineering Approach*, McGraw-Hill.

2.M. J. Moran and H. O. Shapiro, *Fundamentals of Engineering Thermodynamics*, John Wiley & Sons.

3. Sonntang, Borgnakke, Van Wylen John, *Fundamentals of Thermodynamics*, Wiley & Sons.

4. T. D. Eastop and A. McConkey, *Applied Thermodynamics and Engineering*, Pearson.

COMMUNICATION SKILLS (HSM-231)

Contact Hours:
Theory =16
Practical = 0
Total = 16

Credit Hours:
Theory = **1.0**
Practical = 0.0
Total = **1.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Demonstrate** written and oral presentation skills by preparing presentation materials/ assignments	Cognitive	3	10
2.	**Adopt** ability to give / receive clear instructions through written communication.	Affective	3	8
3.	**Analyze** the technical reports in the light of literature review.	Cognitive	4	12

Specific Objectives of course:

- To enable the students to meet their real life communication needs

Course Outline:

1. **Speaking Skills**
   a. Phonetics in effective Communication
   b. Phonetic Transcription
   c. Pronunciation
   d. Varieties of English
   e. Stress and Intonation
   f. Barriers in Effective Verbal Expression
   g. Art of Discussion and Debate
   h. Public Speaking.
   j. Vocabulary Building.

2. **Reading Skills:**
   a. Structure of English Language
   b. Grammar and Syntax
   c. Skimming of gist of a Text
   d. Scanning for specific information
   e. Fast Reading
   f. Understanding of punctuation
   g. Understanding context
   h. Understanding the relationship between sentences and clauses in a text
   i. Recognizing the effects of style
   j. Making inferences
3. **Presentation and listening skills:**
   a. Principles of Technical Communication
   b. Multimedia and Paper Presentations
   c. Presentation Practice by the students.
4. **Essay writing:** Introduction
5. **CV and job application**
6. **Academic skills:** Letter / memo writing and minutes of the meeting, use of library and internet recourses

Note: documentaries to be shown for discussion and review

RECOMMENDED BOOKS(Latest Edition):

1. Read Better, Writye better – Reader's Digest Compilation.
2. Gliden H.K, Reports, Technical Writing, and Specifications; London, McGraw-Hill.
3. Steve M.Gerson/Sharon J. Gerson Technical Writing; Addison Wesley Longman (Singapore) Ltd.
4. Better Vocabulary by Edie Schwager
5. Brian Tomlinson and Rod Ellis, Reading. Advanced. Oxford Supplementary Skills.
6.John Langan, Reading and Study Skills

MECHANICS OF MATERIALS-I (BME-232)

Contact Hours:
Theory =48
Practical = 0
Total = 48

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**State** the basics of mechanics of materials and their mechanical properties	Cognitive	1	1
2.	**Calculate** the stresses and strains in mechanical structures.	Cognitive	2	2
3.	**Solve** problems of bending, torsion and deflection in mechanical structures.	Cognitive	3	2

COURSE OUTLINE:

1. Mechanical properties of materials; tensile, compressive and shear stress & strain
2. Moment of inertia
3. Axial loading, Hooke's law, stress strain relationship
4. Thermal stresses
5. Torsion of circular bars,
6. Pure bending of beams, shear stresses in beams
7. Shearing force and bending moment
8. Beam deflection using various methods
9. Residual stresses and stress concentration in various engineering applications
10. Analysis of statically indeterminate problems,
11. Thin curved bars,
12. Thin walled pressure vessels.

Teaching Methodology

- Lecturing
- Written Assignments
- Report writing

Assessment

Mid Term, Report writing/Presentation, Assignments, Quizzes, Final Term

TEXT AND REFERENCE BOOKS(Latest Edition):

1. James M. Gere, Barry J. Goodno, *Mechanics of Materials*
2. Ferdinand P. Beer & Russel Johnston Jr., *Mechanics of Materials* ,McGraw-Hill
3. R. C. Hibbeler, *Mechanics of Materials*
4. P. P. Benham& R. J. Crawford, *Mechanics of Engineering Materials*, Longman
5. Popov, *Mechanics of Materials*.
6. W. A. Nashi, *Static and Mechanics of Materials*, Schaum's outline series New York.

PAKISTAN STUDIES (ISM-233)

Contact Hours:
Theory = 32
Practical = 0
Total = 32

Credit Hours:
Theory = **2.0**
Practical = 0.0
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Demonstrate** the understanding of political and constitutional system of Pakistan	Cognitive	2	6
2.	**Analyze** the contemporary problems faced by Pakistan (social, human resource, economic development, food safety / water resources) through discussion	Cognitive	4	6
3.	**Discuss** the ethical codes of a Pakistani national.	Cognitive	2	8

SPECIFIC OBJECTIVE OF COURSES:

- To highlight the historical, cultural, religious and social importance of Kashmir.
- To highlight the value of history for a better understanding of Kashmir.
- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan and
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

COURSE CONTENTS:

Historical Perspective of Pakistan

a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
b. Factors leading to Muslim separatism
c. People and Land

i. Indus Civilization
ii. Muslim advent
iii. Location and Geo-Physical features**.**

Government and Politics in Pakistan

Political and constitutional phases:

a. 1947-58
b. 1958-71
c. 1971-77
d. 1977-88
e. 1988-99
f. 1999 onward

Contemporary Pakistan

a. Economic institutions and issues
b. Society and social structure
c. Ethnicity
d. Foreign policy of Pakistan and challenges
e. Futuristic outlook of Pakistan

RECOMMENDED BOOKS:

1. L A Sherwani (Editor), Speeches, *Writings and Statements of Iqbal*, Iqbal Academy, Lahore,1995
2. *The New Oxford Atlas for Pakistan*, Oxford University Press, Karachi, 1998 *Jinnah: Speeches and Statements 1947-48*, Oxford University Press, Karachi, 2000
3. The Emergence of Pakistan, Chaudhry Muhammad Ali, University of the Punjab, Lahore, 1979.
4. K A Saeed, *The Economy of Pakistan, Oxford University Press, Karachi*, 2007
5. J Briscoe, U Qamar, *Pakistan's Water Economy: Running Dry*, Oxford University Press, 2006.
6. J M Kenoyer, *Ancient Cities of the Indus Valley Civilization*, Oxford University Press, Karachi,1998
7. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.
8. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
9. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.
10. Mehmood, Safdar. Pakistan Political Roots & Development.Lahore, 1994.
11. Wilcox, Wayne.The Emergence of Banglades., Washington: American Enterprise, Institute of Public Policy Research, 1972.
12. Issue in Pakistan's Economy by Akbar S. Zaidi.
13. Pakistan's Foreign Policy: A Reappraisal by Shahid Amin Mahmood.

14. Human Rights Pakistan Studies Compulsory HEC, Islamabad

THERMODYNAMICS-II (BME-234)

Pre-Requisite: BME-127

Contact Hours:
Theory = 48
Practical = 48
Total = 96

Credit Hours:
Theory = **3.0**
Practical = 1.0
Total = 4**.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Analyze** thermodynamics cycles of power, refrigeration, and air-conditioning using energy and exergy principles.	Cognitive	4	2
2.	**Apply** the laws of thermodynamics to the chemical and phase equilibrium problems.	Cognitive	3	2
3.	**Understand** the implications of thermodynamics systems on the environment.	Cognitive	2	7
4.	**Operate** various thermodynamics systems under different conditions and analyze their performance.	Psychomotor	3	4

COURSE OUTLINE:

1. **Review of Thermodynamics I**
   a. Energetics
   b. Efficiency
2. **Exergy**
   a. Exergy balance
   b. Exergetic efficiency
3. **Gas Power Cycles**
   a. Air-Standard-Otto cycle
   b. Diesel cycle,
   c. Dual and Brayton cycle

d. Regenerative gas turbines with reheat & inter cooling
e. Combined cycles

4. **Vapor and Combined Power Cycles**
    a. Modeling and analyzing
    b. Superheat and Reheat vapor power cycles
    c. Regenerative vapor power cycles
    d. Other vapor cycle aspects

5. **Refrigeration Cycles**
    a. Vapor compression refrigeration systems
    b. Cascade and Multistage systems
    c. Absorption refrigeration, Heat pump, and Gas refrigeration systems
6. **Thermodynamic Property Relations and Gas Mixtures**
    a. Mixture composition
    b. P-v-T relations for gas mixtures
    c. U, H, S and specific heats for gas mixtures.
7. **Chemical Reactions**
    a. Combustion process and conservation of energy in reacting systems
    b. Importance of mathematical relations
8. **Chemical and Phase Equilibrium**
    a. Equilibrium fundamentals
    b. Chemical potential and equilibrium.

Teaching Methodology

- Lecturing
- Written Assignments

Assessment

Mid Exam, Final Exam, Assignments, Quizzes, Computational Assignment

TEXT AND REFERENCE BOOKS:

1. Yunus A. Cengel and Michael A. Boles, *Thermodynamics, An Engineering Approach*, McGraw-Hill.
2. M. J. Moran and H. O. Shapiro, *Fundamentals of Engineering Thermodynamics*, John Wiley & Sons.
3. Sonntang, Borgnakke, and Van Wylen, *Fundamentals of Thermodynamics*, John Wiley & Sons.
4. Ibrahim Dincer and Marc A. Rosen, *Exergy: Energy, Environment, and Sustainable Development,* Springer.
5. T.D. Eastop and A. McConkey, *Applied Thermodynamics and Engineering*, Pearson.

ELECTRICAL ENGINEERING (BEE-235)

Contact Hours:
Theory =32
Practical = 48
Total = 80

Credit Hours:
Theory = **2.0**
Practical = **1.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**Discuss** basic concepts, network laws and theorems of linear circuit analysis.	Cognitive	2	1
2.	**ANALYZE** linear circuits using network laws and steady state response of resistive and reactive elements to AC excitation.	Cognitive	4	2
3.	**Illustrate** operating principles of fundamental components of electric machines such as motors, generators and transformers including synchronous, asynchronous, DC and special purpose AC, DC generators and transformers.	Cognitive	3	2
4.	**Demonstrate** use of primary electronic lab instruments including DMM, Function Generator, Oscilloscope and electronic trainer.	Psycho motor	3	1
5.	**Execute** electronic circuits using MULTISIM.	Psycho motor	3	5

SPECIFIC OBJECTIVES OF COURSE:

To explain sources and circuit parameters of electrical systems, circuit laws and theorems governing electric circuits. Electromagnetism, electrostatics, and AC fundamentals are also included to lay a strong foundation of electrical engineering.

COURSE OUTLINE(Theory):

Basic Concepts and Circuit Elements: System of units. Energy. Electric Charge, current, electromotive force and potential difference. Ohm's Law. Resistors, conductors and insulators. Active and passive circuit elements. Dependent and independent current and voltage sources. Simple DC Circuits: Series circuits, Parallel networks. Kirchhoff's laws. Power and energy. Resistivity. Temperature co-efficient of resistance.
Capacitance and Capacitors: Hydraulics analogy. Capacitance. Charging and discharging, series and parallel connection of capacitors. Relative permittivity dielectric strength.

Electromagnetism & magnetic Circuits: Magnetic field and flux due to and electric current. Solenoid. Force on current carrying conductor. Magnitude and direction of induced emf Magneto motive force, field strength and reluctance. Comparison of electric and magnetic circuits. Determination of B/H Characteristic.

Inductance in a DC Circuit: Inductive and non-inductive circuit. Inductance of air-cored & iron-cored coil. Growth and decay of current in LR circuit. Energy storage. Mutual inductance and coupling co-efficient.

AC Fundamentals: Generation of single phase and three phase alternating emf, Relationship between frequency, speed and number poles. RMS, average, instantaneous and Peak Values of sinusoidal waveform. Voltages and currents in star and delta circuits. Inductive reactance and impedance of RL load. Phasor representation of alternating quantity. Active, reactive and apparent powers, power factor and power triangle. Working principle of transformer.

RECOMMENDED BOOKS

1. *Electric Circuits, Basic Electricity by Schaum's Series*
2. S Chapman, *Electric Machinery Fundamentals*, 4th ed, McGraw Hill, 2003
3. T Wildi, *Electric Power Technology*, John Wiley & Sons, 1981
4. M Nahvi, J Edminister, *Electric Circuits, Basic Electricity, Schaum's Series*, 4th ed, McGraw Hill, 2002

COURSE CONTENTS(Lab):

The lab consists of experiments on electric circuits comprising common important electronic components.

RECOMMENDED TEXTS:

1. Lab Manual

COMPLEX VARIABLES & TRANSFORMS (GSM-236)

Contact Hours:
Theory = 48
Practical = 00
Total = 48

Credit Hours:
Theory =3**.0**
Practical = **0.0**
Total = 3**.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**Solve** Partial Differential Equations for common Engineering systems.	Cognitive	3	2
2.	**Demonstrate** the concepts of Fourier Series /Fourier Transform to solve PDEs.	Cognitive	3	2
3.	**Carry out** the expansion of the given series using complex analysis.	Cognitive	3	2

SPECIFIC OBJECTIVES OF COURSE:

- The aim of this course is to enable the students to understand the concept and applications of Fourier series, Laplace Transformation, Complex Analysis and Partial Differential Equations .

COURSE OUTLINE

Fourier Series and Transforms: Concept of periodic functions , Fourier series representation of periodic functions , even and odd functions ,Fourier and Laplace transforms and applications ,Laplace trans formation, invers e Laplace and its linearity, transforms of derivatives and integrals , s -shifting, t-shifting and unit step function, differentiation and integration of transforms ,convolution integral equation, partial fractions, system of differential equation, periodic functions with applications .

Complex Analysis: Complex numbers, complex plane and representation of complex number in polar form, addition/subtraction, multiplication, division, powers and roots of complex numbers, complex functions, differentiation and integration, Cauchy-Riemann equations, Taylors , Laurent's

and power series, singularities, residues and residue theorem in complex integration, introduction to conformal transformation and mapping.

Series Solution of Differential Equations: Power series method, theory of power series and method, Legendre's equation and Legendres polynomials, Frobenius method, Bessel's equation and Bessel's functions with properties

Partial Differential Equations and their Applications: Basic concepts, formation and its solutions, linear and non-linear first order partial differential equations and their solutions, separation of variables , applications-one dimensional wave equation and its solution by separation of variable and D-Alembert's method, one dimensional heat flow, two dimensional heat flow, solution of Laplace equation, vibrating membrane-two dimensional wave equation.

RECOMMENDED BOOKS:

1. J. W. Brown & R. V. Churchill, *Complex Variables & Applications,* 10th Edition.
2. J. H. Mathew & Howells, *Complex Analysis for Mathematics & Engineering*, 6th Edition.
3. I. N. Sneddon, *Elements of Partial Differential Equations,* Dover Publications, 2006.
4. R. Haberman , *Elementary Applied Partial Differential Equations,* Prentice Hall Inc., 1983.
5. G. B. Thomas, R L Finney, *Calculus and Analytic Geometry,* AWL, 10th Edition, 2002.
6. E Kreyszig, *Advance Engineering Mathematics*, John Wiley and Sons, 9th Edition, 2005.

ELECTRONICS ENGINEERING (BEE-241)

Contact Hours:
Theory = 32
Practical = 48
Total = 80

Credit Hours:
Theory = **2.0**
Practical = **1.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**Comprehend** the fundamental concepts of digital logic design including gates, number systems, binary coded systems and basic components of combinational and sequential circuits.	Cognitive	2	1
2.	**Solve** small scale circuits consisting of semiconductor devices.	Cognitive	3	2
3.	**Demonstrate** the basic architecture of microcontroller and microprocessor in the laboratory.	Psychomotor	2	4

Specific Objectives of course:

The course covers the elementary concepts required for the analysis and design of electronic circuits

COURSE OUTLINE:

Semiconductors, rectifiers, amplifiers, transistors, relays, inductive and capacitive oscillators, carrier frequency, superimposition of signal frequency, frequency to voltage conversion, LVDT, signal conditioning, operational amplifiers, sinusoidal and square wave forms generation,, pulse-time delay generator, triggering circuit.

Number systems, Boolean algebra, gates, combinational logic, adders, comparators, decoders, multiplexers, etc., sequential logic, flip-flops, registers, counters, ROM, PROM, EPROM, microprocessors, registers, ALU CU memory, address, data and control buses. ADC and DAC, micro-controllers, microprocessors.

RECOMMENDED BOOKS

1. Floyd, *Electronic Devices*, 8th ed, Prentice Hall, 2007
2. Malvino, A Paul, *Electronic Principles*, 7th ed, McGraw Hill, 2006
3. Malvino, *Digital Computer Electronics*, 3rd ed, Career Education, 1992

NUMERICAL ANALYSIS (GSM-242)

Contact Hours:	**Credit Hours:**
Theory = 32	Theory = **2.0**
Practical = 48	Practical = **1.0**
Total = 80	Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**DESCRIBE** fundamentals of different numerical methods.	Cognitive	2	1
2	**APPLY** learned numerical methods to solve different engineering problems.	Cognitive	3	2
3	**Demonstrate** skills for design and implementation of various numerical algorithms.	Cognitive	3	5

COURSE OUTLINE:

Introduction, significant digits, precision, accuracy, error, truncation errors & Taylor series, systems of linear algebraic equations, properties of matrices and determinants, Cramer's rule, simple elimination, pivoting, scaling, Gauss elimination, Gauss – Jordan elimination, matrix inverse method, LU factorization, eigenvalue problems, nonlinear equations, introduction, closed domain methods (Bisection method, Regula falsi method), open domain method (Newton – Raphson method, secant method), roots of polynomials, optimization, Newton's method, quadratic interpolation, constrained optimization, polynomial approximation & interpolation,

direct fit polynomials, divided difference tables & divided difference polynomials, Lagrange polynomials, difference tables & their corresponding polynomials, Newton's forward & backward difference polynomial, splines, numerical differentiation, difference formulas, Taylor series method, numerical integration, Newton cotes formulas (trapezoid rule, Simpson's 1/3 rule, Simpson's 3/8 rule), Gauss quadrature, ordinary differential equations, initial value ODE, Taylor series method, Euler methods, second order Runge- Kutta methods, boundary value ODE, finite difference method, eigenvalue problems, Application of Matlab.

RECOMMENDED BOOKS

1. Steven C. Chapra, Raymond P. Canale, *Numerical Methods for Engineers, with Software and Programming Applications,* McGraw-Hill Education, 4th Edition 2001.
2. Joe D. Hoffman, *Numerical Methods for Engineers & Scientists,* 2nd Edition, CRC Press 2001.
3. Myron B. Allen, Eli L. Isaacson, *Numerical Analysis for Applied Sciences.*
4. E Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons, 2005.
5. R L Burden, J D Faires, *Numerical Methods,* 3rd Edition, PWS, 2002
6. R L Burden, J D Faires, *Numerical Analysis,* 7th Edition, Brooks Cole, 2001.
7. César Pérez López, *MATLAB programming for numerical analysis,* Apress, New York, 2014.
8. Laurene V Fausett, *Applied numerical analysis using MATLAB,* Pearson, 2011.

Practical/ Lab Work: MATLAB and softwares relating subject contents.

ISLAMIC STUDIES/ETHICS (ISM-243)

Contact Hours:
Theory = 32
Practical = 00
Total = 32

Credit Hours:
Theory = **2.0**
Practical = **0.0**
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
2.	**DESCRIBE** the role and responsibility of Muslims through the texts of Holy Quran and Hadith.	Cognitive	2	8
3.	**EXPLAIN** Islam as the practical code of life for all times.	Cognitive	2	8
4.	**STATE** the relevance of Islamic teachings to social and economic developments of modern age.	Cognitive	1	6

Specific Objectives of course:

This course is aimed:

- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life.

COURSE OUTLINE:

Introduction to Quranic Studies

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul -Quran

Study of Selected Text of Holly Quran

1. Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi(Verse No-1-18)
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)

5. Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Study of Selected Text of Holly Quran

1. Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

1. Life of Holy Prophet (S.A.W) in Madina
2. Important Events of Life Holy Prophet in Madina
3. Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom –ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction to Islamic Law & Jurisprudence

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law

Islam and Sectarianism
Islamic Culture & Civilization

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

Islam & Science

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science

3. Quranic & Science

Islamic Economic System

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

Political System of Islam

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

Islamic History

1. Period of Khlaft-e-Rashida
2. Period of Ummayyads
3. Period of Abbasids

Social System of Islam

1. Basic Concepts of Social System of Islam
2. Elements of Family
3. Ethical Values of Islam

RECOMMENDED BOOKS:

1. Hameed ullah Muhammad, "Emergence of Islam" , IRI, Islamabad
2. Hameed ullah Muhammad, "Muslim Conduct of State"
3. Hameed ullah Muhammad, 'Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,"
5. Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.
6. Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad (1993)
7. Mir Waliullah, "Muslim Jurisprudence and the Quranic Law of Crimes" Islamic Book Service (1982)
8. H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989)

MECHANICS OF MATERIALS-II (BME-244)

Contact Hours:
Theory =48
Practical = 48
Total = 48

Credit Hours:
Theory = **3.0**
Practical = 1.0
Total = **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Analyse** stresses and strains in two- and three-dimensions using different technique.	Cognitive	4	2
2.	**Understand** theories of failure of materials	Cognitive	2	1
3.	**Solve** problems related to early failure of materials under special conditions like fatigue, creep etc.	Cognitive	2	2
4.	**Operate** various systems to determine material behavior using experimental setups.	Psychomotor	3	4

COURSE OUTLINE(Theory):

1. Analysis of stress and strain in two and three dimensions
2. Principal stresses and strains
3. Mohr's circle for stress and strain
4. Thick walled pressure vessels
5. Symmetrical and asymmetrical loading
6. Introduction to fracture mechanics
7. Impact loading
8. Fatigue and creep
9. Virtual work
10. Theories of elastic failure
11. Theory of columns

Teaching Methodology

- Lecturing

- Written Assignments
- Field Visits
- Report Writing

Assessment

Mid Term, Report writing/Presentation, Assignments, Quizzes, Final Term

TEXT AND REFERENCE BOOKS:

1. E J Hearn, *Mechanics of Materials Volume 1 & 2*
2. Ferdinand P. Beer & Russel Johnston Jr., *Mechanics of Materials*, McGraw-Hill
3. Popov, *Mechanics of Materials*
4. P. P. Benham & R. J. Crawford, *Mechanics of Engineering Materials*, Longman Sci & Tech
5. Boresi, Arthur P., Schmidt, Richard J. Sidebottom, Omar M., *Advanced Mechanics of Materials*
6. R. C. Hibbeler, Mechanics of Materials
7. Andrew Pytel and F. L. Singer, *Strength of Materials*
8. W. F. Riley, L. D. Sturges and D. H. Morris, *Mechanics of Materials*.
9. W. A. Nashi, *Statics and Mechanics of Materials*, Schaum's outline series New York.

COURSE OUTLINE(Lab):

Experiments related to the Mechanics of Materials-I & II will be covered.

Teaching Methodology

- Demonstration
- Lab Report Writing

Assessment

Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:

Lab Manual

MACHINE DESIGN-I (BME-245)

Contact Hours:
Theory = 48
Practical = 00
Total = 48

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the application of design standards and the importance of dimensional parameters in manufacturing aspects of mechanical design.	Cognitive	2	1
2.	**Develop** calculations to determine the sizing of structural joints, power transmitting shafts and mechanical springs.	Cognitive	5	3
3.	**Analyse** the stresses in various machine elements.	Cognitive	4	2

COURSE OUTLINE:

Introduction
- Design philosophy
- Types of design

Mechanical behaviour of materials
- Concepts of stress and strain
- Different types of stress and strain in a machine element
- Stress-strain diagram
- Actual and permissible stresses
- Factor of safety

Design of keys and coupling
- Basic concepts
- Methodology

Design of Riveted joint, Welded joints, Bolted joints
- Basic concepts
- Methodology

Design of Springs, Shafts
- Basic concepts
- Methodology

Metal fits and tolerances and Design Standards
- Basic concepts of tolerance

- Types of fits
- ISO standard fits charts

Teaching Methodology

- Lecturing
- Written Assignments
- Guest Speaker
- Report Writing and Presentation

Assessment

Mid Exam, Final Exam, Assignments, Quizzes, Computational Assignment

TEXT AND REFERENCE BOOKS (Latest Editions):

1. Robert L. Mott ,*Machine Elements in Mechanical Design*
2. Robert L. Norton, *Design of Machinery*
3. R. S. Khurmi & J. K. Gupta, *A Textbook of Machine Design*
4. Joseph E. Shigley, *Theory of Machines & Mechanisms*

FLUID MECHANICS – I (BME-246)

Contact Hours:
Theory =48
Practical = 0
Total = 48

Credit Hours:
Theory = **3.0**
Practical = 0.0
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Solve** hydrostatic fluid problems.	Cognitive	3	1
2.	**Analyze** the fluid kinematics and dynamics parameters using basic laws of mechanics.	Cognitive	3	2
3.	**Carry out** pipe flow problems using Bernoulli and energy equation.	Cognitive	3	2
4.	**Understand** the concept of dimensional analysis.	Cognitive	2	1

COURSE OUTLINE:

1. **Fluid Properties**
   a. Definition of fluid and its classification
   b. Concept of continuum.
   c. Properties of the fluid.

2. **Fluid Statics**
   a. Concept of Pressure and basic equations for compressible and incompressible
   b. Pressure measurements and devices.
   c. Hydrostatics forces on plane and curved surfaces.
   d. Buoyancy and Stability.
   e. Pressure variation in fluid with rigid body motion.

3. **Fluid Kinematics**
   a. Flow characteristics, Descriptions of Velocity and acceleration field (Streamlines, streak lines and path lines).
   b. Control volume and representation of system.
   c. Deriving Reynolds transport theorem (RTT).

4. **Fluid Dynamics**
   a. Application of Newton's 2nd law in fluids.
   b. Total, stagnation and dynamic pressure.
   c. Deriving Bernoulli equation and its applications.

5. **Integral Analysis of Fluid Flow**
   a. Deriving continuity equation using RTT.
   b. Deriving linear momentum equation using RTT.
   c. Deriving moment of momentum equation using RTT.

6. **Dimensional Analysis, Similitude and Modeling**
   a. Dimensional analysis
   b. Buckingham Pi theorem and determination of Pi terms

7. **Flow in Pipes**
   a. Characteristics of pipe flow laminar and turbulent.
   b. Calculating friction factor and wall shear stresses.
   c. Solving pipe flow network problems

Teaching Methodology

- Lecturing
- Written Assignments
- Field Visits
- Report Writing

Assessment

Mid Exam, Final Exam, Quizzes, Assignments,

TEXT AND REFERENCE BOOKS:

1. Munson, Young And Okiishi HT John, *Fundamentals Of Fluid Mechanics*, J. Wiley & Sons.
2. Philip J. Pritchard and John C. Leylegian, *Fox and McDonald's Introduction to Fluid Mechanics*, J. Wiley & Sons.
3. Frank M White, *Fluid Mechanics*. McGraw Hill.

FLUID MECHANICS – II (BME-351)

Pre-Requisite: BME-246

Contact Hours:
Theory =48
Practical = 48
Total = 96

Credit Hours:
Theory = **3.0**
Practical = 1.0
Total = **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Translate** governing equations to incompressible and compressible fluid flows.	Cognitive	2	1
2.	**Illustrate** the scaling laws for the performance of various fluid flow devices.	Cognitive	3	2
3.	**ANALYZE** the performance of various hydraulic machines.	Cognitive	4	2
4.	**Investigate** various fluid flow parameters using experimental setups.	Psychomotor	3	4

COURSE OUTLINE(Theory):

1. **Differential Analysis of Fluid Flow**
   a. Deriving continuity equation by applying conservation of mass principle.
   b. Evaluating velocity and acceleration field using material derivative.
   c. Deriving Navier-Stokes equation and some simple analytical solution

2. **Potential flow theory**
   a. Concept of vorticity, Circulation, Inviscid and Irrotational flow field
   b. Basic velocity potential function and its superposition.
   c. Prediction of Lift and drag using potential flow theory

3. **Flow over immersed bodies**
   a. Boundary layer theory and its thicknesses.
   b. Concept of local and average drag coefficient.
   c. Calculating drag and lift forces due to pressure and velocity field.

4. **Introduction to Computational Fluid Dynamics**
    a. Finite difference formulation
    b. Solving basic fluid flow problems using available CFD code.

5. **Compressible Flows**
    a. Mach number and speed of sound
    b. Isentropic flow of an ideal gas
    c. Convergent divergent Nozzle

6. **Turbomachinery**
    a. Fans, Pumps, turbines and other flow devices.
    b. Deriving Euler's equation and solving of turbo-machine problems using velocity triangle
    c. Pump and turbine performance characteristic curves.

Teaching Methodology

- Lecturing
- Written Assignments
- Field Visits
- Report Writing

Assessment

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS:

1. Munson, Young, Okiishi, Huebsch, *Fundamentals of Fluid Mechanics*, 6th ed, Wiley, 2009
2. F M White, *Fluid Mechanics*, 6th ed McGraw Hill, 2006
3. Philip J. Pritchard and John C. Leylegian, *Fox And McDonald's Introduction To Fluid Mechanics*, Wiley & Sons.
4. I Shames, *Fluid Mechanics*, 4th ed, McGraw Hill, 2002
5. C T Crowe, D F Elger, *Engineering Fluid Mechanics*, 9th ed, Wiley, 2008

COURSE OUTLINE(Lab):

Experiments related to the Fluid Mechanics-I & II will be covered to:

- understand the state of fluids and their characteristics when subject to various loads.
- visualize various laws that govern fluid mechanics and explore their applications.
- apply basic concepts to hydrostatic fluid problems.

- analyze the fluid kinematics and dynamics parameters using basic laws of mechanics.
- solve pipe flow problems using Bernoulli and Energy Equations.
- understand the concept of dimensional analysis.
- apply the governing equations to incompressible and compressible fluid flows.
- calculate fluid flow parameters for various geometries.

Teaching Methodology

- Demonstration
- Lab Report Writing

Assessment

Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

TEXT BOOK

- Lab Manual, Fluid Mechanics Lab, MED,

HEALTH, SAFETY & ENVIRONMENT (HSM-352)

Contact Hours:	**Credit Hours:**
Theory = 16	Theory = **1.0**
Practical = 00	Practical = **0.0**
Total = 16	Total = **1.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Comprehend** the philosophy of Safety Health and Environment.	Cognitive	2	7
2.	**Apply** the Safety Health and Environment concepts in given organizational Environment	Cognitive	3	8
3.	**Describe** the role and responsibilities of engineers to the environment.	Cognitive	2	6

COURSE OUTLINE:

Introduction of Health and Safety, Industrial Safety: introduction objectives of Safety, Importance of Safety in an industry, Industrial accidents, Effects of accidents, Types of accidents incidence of fire. Fire prevention and control.
Principles of accident prevention, hazard analysis. Legal, humanitarian and economic reason for action. Safety inspection procedures. Safety training, First aid and emergency procedures,.

Introduction: importance of clean environment, Scale of Environmental Pollution. Environmental Act. Health and Safety Act.

Atmospheric Pollution: Types of Atmospheric pollution, Their Causes and Effects on Human Health, Available Technologies for Controlling Pollution. Industrial Waste: Solid Waste, Industrial Effluents and Waste Gases, waste treatment plants.

Noise Pollution: Measurement of Noise level, Effect of excessive noise on human health. Remedial Measures. ISO Standards for Safety and Health and Environment.

Professional Ethics: the nature of a profession, professional codes of ethics, confidentiality, whistle-blowing, uses and abuses of human research, and ethics in research.

RECOMMENDED BOOKS:

1. Safety at Works 4th Edition By John Ridley, Butter Worths Publishers
2. Factory & Production Management By K.G. Lockyer, Pitman Publishing

MACHINE DESIGN-II (BME-353)

Pre-Requisite: BME-245

Contact Hours: **Credit Hours:**

Theory = 32	Theory = **2.0**
Practical = 00	Practical = **0.0**
Total = 32	Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Analyse** the parameters for the selection of standard machine elements.	Cognitive	4	2
2.	**Design** the machine elements for desired outputs, including gears, flywheels, clutches, brakes, journal bearings, rolling contact bearings, power screws, chains and belts etc	Cognitive	5	3
3.	**Evaluate** the design of gears, flywheels, power screws by through a stresses analysis.	Cognitive	6	3

COURSE OUTLINE:

Spur, Helical, Bevel and Worm Gears

- Stress analysis on gear teeth
- Power transmission by the gears

Design of Flywheels

- Concepts of designing flywheels for different requirements

Selection of bearings

- Selection procedures of sliding contact bearings and rolling contact bearings

Design of Brake / Clutches

- Different types of clutches and designing concepts
- Different types of brakes and designing concepts

Design of Power Screws / Translation Screws

- Introduction to power / translational screws
- Stresses in power / translational screws
- Efficiency of power / translational screws
- Applications of power / translational screws

Selection of Standard Machine Elements

- Selection of flat belts, V belts, chain drive and rope drives

Teaching Methodology

- Lecturing
- Design/Selection Assignments

Assessment

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS (Latest Editions):

1. Robert L. Mott, *Machine Elements in Mechanical Design*
2. Robert L. Norton, *Design of Machinery*
3. Joseph E. Shigley, *Theory of Machines & Mechanisms*

APPLIED STATISTICS (GSM-354)

Contact Hours:	**Credit Hours:**
Theory =48	Theory = **3.0**
Practical = 0	Practical = 0.0
Total = 48	Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO Statement	Domain	Learning Level	PLO
1	**DESCRIBE** the basic concepts of probability and statistics used for data representation and sampling	Cognitive	2	1
2	**APPLY** the probability theory to analyse data for decision making and for solving problems.	Cognitive	3	2
3	**DEMONSTRATE** contribution as an individual and team member by participating in a project	Cognitive	3	9

SPECIFIC OBJECTIVES OF COURSE:

1. Analyze data and graphs in real world scenarios to recognize what probability and statistics are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, then judge if the results are reasonable and clearly interpret the results via written or oral communication.
2. Recognize probability and statistics concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.

COURSE OUTLINE:

1. Introduction
   The instructional goal is to explore how an understanding of statistics is beneficial to jobs in business, industry, government, medicine, and other fields.
   - Describe and discuss descriptive and inferential statistics.
   - Identify and describe common statistical terminology:
     - population.
     - sample.
     - variable.

- statistical inference.

2. Describing Sets of Data
   The instructional goal is to explore, analyze, and describe a set of data using graphical and numerical methods.
   - Identify qualitative and quantitative data.
   - Construct bar charts.
   - Interpret pie charts and bar charts.
   - Construct frequency and relative frequency distributions.
   - Construct frequency and relative frequency histograms.
   - Construct a stem-and-leaf display.
   - Construct a dotplot.
   - Describe the shape of a distribution as symmetric, skewed left, or skewed right.
   - Calculate and interpret the numerical measures of central tendency:
     - mean.
     - median.
     - mode.
   - Calculate and interpret the numerical measures of dispersion:
     - range.
     - inter-quartile range.
     - variance.
     - standard deviation.
   - Interpret the meaning of the standard deviation using the Empirical Rule and/or Chebyshev□™s Rule.
   - Calculate and interpret measures of relative standing:
     - percentile ranking.
     - zz -scores.
   - Construct a modified boxplot.
   - Look for relationships between two variables:
     - Identify response and explanatory variables.
     - Construct a scatterplot.
     - Determine whether the two variables have a positive or negative association.
     - Calculate and interpret the correlation coefficient, rr , and the coefficient of determination, r2r2 .
     - Calculate and interpret the least-squares regression line.
     - Predict values of the dependent variable using the least-squares regression line.
     - Discuss cautions about regression and correlation including:
       - residuals.
       - lurking variables.
       - causation.
   - Using technology,
     - input and edit data.
     - draw dotplots, histograms, boxplots, scatterplots, and residual plots.
     - calculate one-variable summary statistics.

3. Producing Data
   The instructional goal is to explore the design of statistical samples and experiments.
   - Identify the elements of experiments and observational studies including:
     - experimental units.
     - factors.
     - placebo.
     - bias.
     - randomization.
   - Identify the differences between experiments and observational studies.
   - Identify sample designs including:
     - voluntary response sample.
     - convenience sample.
     - simple random sample.
     - stratified sample.
     - multistage sample.
     - systematic sample.
     - cluster sample.
   - Using technology or a table of random numbers select a simple random sample.
4. Elementary Probability
   The instructional goal is to explore the concepts of probability.
   - Identify and describe standard probability terms:
     - experiment.
     - simple event (aka outcome).
     - sample space.
     - disjoint events.
     - independent events.
     - complementary events.
   - Calculate and interpret marginal, joint, and conditional probabilities.
   - Calculate and interpret probabilities using:
     - Venn diagrams
     - contingency tables.
     - tree diagrams.
     - additive rule.
     - multiplicative rule.
   - Calculate probabilities using Bayes□™ Theorem.
5. Random Variables and Probability Distributions
   The instructional goal is to explore and analyze various random variables and probability distributions.
   - Identify and describe terminology:
     - random variable.
     - probability distribution.
     - expected value.
     - variance and standard deviation.
     - probability density function.
   - Identify a random variable as discrete or continuous.
   - Explore the binomial discrete probability distribution.

- Explore the normal continuous probability distribution.
- Approximate a binomial probability using a normal distribution.
- Using technology, input a probability density function and its appropriate parameters.
    - Compute and interpret the probability that a discrete random variable is equal to a specified value.
    - Compute and interpret the probability that a discrete random variable lies within an interval of values.
    - Compute and interpret the probability that a continuous random variable lies within an interval of values.
- Using technology, simulate probability distributions by generating random data.
    - Binomial.
    - Normal.
- Compute and interpret the mean and standard deviation of
    - a discrete random variable.
    - a linear transformation of a random variable.
    - the sum or difference of two independent random variables.

6. Sampling Distributions

   The instructional goal is to explore and analyze sampling distributions.
    - Identify and describe terminology:
        - parameter.
        - statistic.
        - point estimator.
        - biased vs. unbiased.
    - Calculate and interpret a sample mean and its standard deviation.
    - Explore the distribution of the means of samples drawn from a population.
    - Identify the properties of sampling distributions.
    - Explore the Central Limit Theorem.
    - Solve probability problems involving the standardized sample mean.
7. Estimation

   The instructional goal is to estimate a population parameter by calculating a confidence interval.
    - Identify and describe terminology:
        - confidence coefficient (aka critical zz -score).
        - confidence level.
    - Calculate and interpret a large-sample estimation of a population mean or proportion.
    - Calculate a sample size to attain a desired margin of error and confidence level.
8. Significance Testing

   The instructional goal is to understand the logic, formal structure, appropriate use, and proper interpretation of significance testing.
    - Identify and describe terminology:
        - Null hypothesis (as an equation)
        - Alternative hypothesis (one-sided and/or two-sided)
        - Significance level (αα-value)
        - PP -value

- Statistical significance
- Performance and interpretation:
  - Specify an appropriate parameter of interest
  - Identify/produce data, and properly set up a basic significance test
  - Be able to compute a PP -value:
    - Using a single (context-specific) significance test software function and/or
    - Using a calculated test statistic and a software Cdf function, and/or
    - Using a normal distribution table.
  - Assess results for statistical significance against a predetermined significance level
  - Distinguish between statistical vs. practical significance
- Compare the information a confidence interval provides versus a significance test.
- Verify required conditions for the test of significance.

RECOMMENDED BOOKS

1. *"Probability and Statistics for Engineering and the Sciences"* by Jay L. Devore, 8th Edition, Brooks/Cole USA 2012.
2. *"Applied Statistics and Probability for Engineers" by* Douglas C. Montgomery, George C. Runger, (5th Edition, John Wiley & Sons USA, 2011).
3. *"Statistics and Probability for Engineering Applications"* by W. J. DeCoursey, (1st Edition, Elsevier Science USA, 2003).
4. *"Probability Theory: The Logic of Science"* by Edwin Thompson Jaynes

HEAT & MASS TRANSFER (BME-355)

Contact Hours:	**Credit Hours:**
Theory =48	Theory = **3.0**
Practical = 48	Practical = 1.0
Total = 96	Total = **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Apply** governing equations of heat transfer to various thermal systems.	Cognitive	3	1
2.	**Analyze** the performance of various heat exchangers under different conditions.	Cognitive	4	2
3.	**Develop** heat exchanger design calculations using temperature and flow rate data.	Psychomotor	5	3
4.	**Conduct** heat transfer measurements in all modes (radiation, convection, conduction) using experimental setups.	Psychomotor	4	4

COURSE OUTLINE(Theory):

1. **Introduction to Heat transfer**
   a. Review of the concepts of equilibrium, steady state, heat and thermodynamics.
   b. Basic modes of heat transfer and their mechanisms.
2. **Conduction**
   a. Deriving heat conduction equation using principle.
   b. Solving heat conduction problems using equivalent electrical networks.
   c. Extended surfaces and their performance parameters.
   d. Transient heat conduction and lumped heat capacity method and its corresponding electrical analogy.
3. **Radiation**
   a. Fundamental characteristics of thermal radiation and surfaces
   b. Laws of black body radiation
   c. Intensity of radiation
   d. Solving problems of radiative heat transfer between surfaces and enclosures using equivalent electrical networks.
4. **Convection**
   a. Deriving energy equation for convection
   b. Heat transfer rate for laminar, turbulent and mixed boundary layers for external flow and internal flow problems.
   c. Buoyancy driven flows and their heat transfer rate for external flow problems and enclosed spaces.
   d. Heat transfer rate for phase change processes i.e. Boiling and condensation.

5. **Heat Exchangers**
    a. Classification and types of Heat exchangers.
    b. LMTD method
    c. NTU-effectiveness method

6. **Mass transfer**

    a. Fick's law of diffusion and mass diffusivity.
    b. Concept of concentration boundary layer.
    c. Solving mass transfer problems using convective heat transfer analogy.

Teaching Methodology

- Lecturing
- Written Assignments
- Field Visits
- Report Writing

Assessment

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS:

1. Incropera & DeWitt, Wiley, *Fundamentals of Heat and Mass Transfer*
2. Mills & Ganesan, Heat Transfer.
3. Frank Kreith, *Principles of Heat Transfer*.
4. J.P. Holman, *Heat and mass transfer*
5. Yunus Cengel, *Heat transfer*
6. Ozisik, *Heat Transfer*
7. D. Pitts, L. E. Sissom, *Heat Transfer*, Schaum's outline series New York.

COURSE CONTENTS (Lab):

Various experiments covering conduction, convection, radiation and heat exchangers will be carried out such as.

- To measure temperature distribution.
- To demonstrate the application of different temperature scales.
- To understand the use of Fourier rate equation.
- To demonstrate the use of extended surface.
- To determine the effect of forced convection on heat transfer.
- To perform energy balance across heat exchangers.
- Demonstration of combined convection and radiation heat transfer from horizontal cylinder.

Teaching Methodology

- Demonstration

- Lab Report Writing

Assessment

Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

RECOMMENDED BOOKS:

1. Lab manuals of PA.Hilton
2. Lab Manuals of EES

MANUFACTURING PROCESSES (BME-356)

Contact Hours:	**Credit Hours:**
Theory =48	Theory = **3.0**
Practical = 48	Practical = 1.0
Total = 96	Total = **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.NO	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the required operation and parameters for performing manufacturing processes.	Cognitive	2	1
2.	**Apply** various manufacturing techniques/ operations to broad range engineering applications.	Cognitive	3	2
3.	**Demonstrate** the working of various machine tools and manufacturing processes in the laboratory.	Psycho motor	4	1

COURSE OUTLINE(Theory):

1. Introduction: Basic concepts of manufacturing processes
2. Casting and Moulding: Metal casting processes and equipment, Powder metallurgy, Plastics
3. Forming: Extrusion and drawing, sheet metal forming, forming and shaping plastics and composite materials
4. Machining: Conventional and non-conventional machining processes
5. Joining: Welding, brazing, soldering, sintering, adhesive bonding, fastening, Press fitting
6. Additive Manufacturing: 3D Printing

Teaching Methodology

- Lecturing
- Written Assignments
- Report Writing
- Video lectures

Assessment

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

Text and Reference books:

1. Mikell P Groover, *Fundamental of Modern Manufacturing: Materials,* Processes and Systems, John Wiley
2. S. Kalpakjian & S. R. Schmid, *Manufacturing Processes for Engineering Materials,* Pearson
3. Stanley A. Komacek, Ann E. Lawson & Andrew C. Horton, *Manufacturing Technology*, Glencoe/Mcgraw-Hill.

COURSE OUTLINE(Lab):

Experiments related to the Manufacturing Processes will be covered.

Teaching Methodology

- Demonstration
- Hand on Experiments
- Lab Report Writing

Assessment

Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:

Lab Manual

TECHNICAL REPORT WRITING & PRESENTATION SKILLS (HSM-361)

Contact Hours:	**Credit Hours:**
Theory =16	Theory = **1.0**
Practical = 48	Practical = 1.0
Total = 64	Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

No	CLO Statement	Domain	Taxonomy Level	PLO
1.	**Describe** formal technical communication conventions found in workplace.	Cognitive	2	10

2.	**Communicate** the data in graphical format through presentation.	Affective	3	10
3.	**Construct** technical documents including but not limited to CV, Cover letter, reports, proposals, research articles, etc.	Cognitive	5	10
4.	**Demonstrate** the role of ethics in preparing communication for an audience of diverse cultures.	Cognitive	3	6
5.	**Identify** the importance of literature review.	Cognitive	1	12

Specific Objectives of course:

To prepare the students for academic reading, writing, oral presentation, reference skills and grammar. The students shall be given practice in communication skills and introduced to the principle of effective writing from the sentence level to full length text with emphasis on logical organization of materials. Writing technical reports, feasibility reports, and proposals. Oral communication is improved through class Seminars.

COURSE OUTLINE:

Technical Writing
Overview of the technical writing process. Writing Letters Memos and Minutes, Applying for a job and resumes, Writing Feasibility and Progress Reports, Writing Proposals, Writing Technical Reports.

Progress report writing
Overview of the field; manuals and handbooks; technical reports; technical articles; technical sales literature; technical training material; technical presentations; educational textbooks; software documentation; outline and design, requirement; specification; outline design; sources of information; library classifications; contacts; meetings; information gathering; verbal information; visual information; synopsis; work schedule; costing; development phase: first draft; style of writing; technical vetting; editing; final draft; commercial books; production phase: camera copy; proofreading; printing; illustrations: technical illustrations; diagrams/line illustrations; perspective drawings; half-tones; validating illustrations; miscellaneous topics: materials and equipment; translations; abstracting and abridging; indexing; development of a documentation system; diagnostic/ maintenance documentation; network planning; copyright; contracts

Note: Extensive reading is required for vocabulary building.
Presentation skills
Personality development (emphasis on content, style and pronunciation)
Note: Documentaries to be shown for discussion and review

RECOMMENDED BOOKS:

1. K R Woolever, *Writing for the Technical Professions*, 4th ed, Longman, 2007

2.Reports, Technical Writing and Specifications, Glidon H.K, 1st edition, McgrawHill, 2000
3. Technical Writing by Steve M. Gerson.
4. Reporting Technical Information by Kenneth W. Houp,
Thomas E. Pearsall, Tebeaux and Dragga Latest Edition.
5. Tech Biz Writing, *TechBiz Writing Course: A Free Course in Technical and Business*
6.Writing which builds gradually into a valuable resource, [Online]:
http://www.techbizwriting.com [Accessed: Mar 11 2008]
7.Technical Communication by Rebecca E. Burnett.

PRACTICAL/ LAB. WORK: Proper Presentations and technical reports must been formulated through laboratory timings.

CONTROL ENGINEERING (BME-363)

Contact Hours:		**Credit Hours:**	
Theory	= 48	Theory	= **3.0**
Practical	= 48	Practical	= 1**.0**
Total	= 96	Total	= **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.NO	CLO	Domain	Taxonomy level	PLO
1.	**Discuss** the construction, working and applications of various sensors and gauges.	Cognitive	2	1
2.	**Develop** mathematical models of different physical systems.	Cognitive	5	3
3.	**Analyze** control engineering problems using mathematical models to examine different properties of the system.	Cognitive	4	2
4.	**Investigate** the response, steady state error, time constant, gain, overshoot, rise time and settling time using experimental setups.	Psychomotor	3	4

COURSE OUTLINE(Theory):

1.Introduction

Basics of control system, Open-loop and closed-loop control systems, Block diagram terminology, Example of system for block diagrams, Signal flow graphs

2.**Dynamic System modeling**

Mechanical Translational & Rotational Systems, Electrical Active & Passive Systems, Electromechanical Systems, Conversion of Electrical System to Equivalent Mechanical Systems and vice versa, Thermal system and fluid systems

3.Laplace Transforms and Transfer Function

Mason Gain Formula to find transfer function, Mason's formula application of electrical and mechanical systems, Development of nodal equations from signal flow graph, Development of signal flow graph from nodal equations

4.State Space Formulation

State space formulation from differential equations, State Space formulation from block diagram and signal flow graphs, Control and Observer Canonical form of block diagrams and state space, Types of inputs like impulse, step, ramp and sinusoidal input, Solution of state space for different responses, System linearization and its applications

5.Time Response of 1st Order and Higher Order2nd Order System

Time response of the 1st and 2nd order systems (impulse, step, ramp etc.), Time response characteristics, Frequency response of 1st and 2nd order systems, Time response of higher order systems

6.Study of System Stability

Introduction to stability, Poles and Zeros concept, Ruth-Hurwitz stability criteria and its applications, Concept of Root-Locus

7.Root Locus Design

Root Locus design, System stability by pole placement, Compensator Design (Lead and Lag Compensator), Design of PID Controller (P, PI and PID Controllers), Different PID Controller Tuning method

8.Frequency Design

Introduction to frequency plots, Bode Plots, System Stability using Bode Plots

Teaching Methodology

- Lecturing
- Tutorial sessions
- Discussions

Assessment

Quizzes, OHTs/Mid Term, Assignments, Final Exam

TEXT AND REFERENCE BOOKS:

1. Charles Phillips & Royce Harbor ,*Feedback Control Systems,* Prentice-Hall
2. Katsuhiko Ogata, *Modern Control Engineering.*
3. Norman S Nise, *Modern Control Engineering.*

COURSE CONTENTS(Lab):

Study the functions and applications of vibration sensor, thermistor, read switch, photo transistors.

Study the PID controller using PCT100.

Study the microcomputer sensing control system.

Introduction to programmable logical controllers using PC45 trainer.

RECOMMENDED TEXTS:

1. Lab manuals

MECHANICS OF MACHINES (BME-364)

Contact Hours:		**Credit Hours:**	
Theory	= 48	Theory	= **3.0**
Practical	= 0	Practical	= 0**.0**
Total	= 48	Total	= **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the mechanics of various machine elements.	Cognitive	2	1
2.	**CALCULATE** the kinematic characteristics of mechanisms such as linkages, cams, gears, governors and unbalance masses.	Cognitive	3	2
3.	**RELATE** analytical and/or graphical solutions of various machines and mechanisms.	Cognitive	4	3

Course outline:

1. **Introduction to Mechanisms**
   Machine & Mechanisms, Mechanism Terminology, Kinematic Diagram, Kinematic Inversion, Four Bar Mechanism, Slider Crank Mechanism, Techniques of Mechanism Analysis

2. **Vector, Position and Displacement Analysis**
   Motion, Vectors, Analytical Vector Methods Applied to the Displacement Analysis of Planar Linkages, Graphical Analysis, Complex-Number Methods Applied to the Displacement Analysis of Linkages, Spatial (Three-Dimensional) Linkages, Computer-Implemented Numerical Methods of Position Analysis

3. **Velocity Analysis of Mechanisms**
   Average Speed in Mechanize Mechanism, Velocity of a Point in Mechanize Mechanism, Angular Velocity in Mechanize Mechanism, Motion of a Rigid Body about a Fixed Axis (Without Translation), Moving Coordinate Systems and Relative Velocity, Application of Analytical Vector and Matrix Methods to Linkages, Four-Bar Linkage, Complex-Number Methods Applied to Velocity Analysis

4. **Acceleration Analysis of Mechanisms**
   Planar Motion, Spatial Motion, Relative Acceleration, Analysis of a Four-Bar Linkage by Analytical Vector Methods, Acceleration Analysis, Position Analysis, The Acceleration Polygon, Graphical Analysis of the Four-Bar Linkage, An Analytical Solution Based on the Acceleration Polygon, Graphical Analysis of Sliding Contact Linkages, Trial Solution Method Applied to Linkage Acceleration Analysis, Spatial Linkages, Acceleration Analysis of an RSSR

5. **Design & Development**
   Mechanism Design
   Time Ratio, Timing Charts, Design of Slider Crank Mechanism, Design of Crank Shaper Mechanism, Mechanism to Move a Link Between Two Positions
   Cams

Types of Cams & Followers, Follower Motion Schemes, Graphical Disk Cam Profile Design, Pressure Angle, Design Limitations

Governors

Types of Governors, Centrifugal Governors, Porter Governors, Parallel Governors, Spring Loaded Governors

Gears

Toothed Gearing, Gear Trains

Teaching Methodology

- Lecturing
- Tutorial sessions
- Discussions

Assessment

Quizzes, Mid Term/One hour tests(OHTs), Term Project, Final Exam

TEXT AND REFERENCE BOOKS:

1. David H. Myszka, *Machines and Mechanisms*.
2. Thomas Bevan, *The Theory of Machines*.
3. John J. Uicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines and Mechanisms*.
4. Robert Ferrier McKay, *The Theory of Machines*
5. J. A. Collins, *Mechanical Design of Machine Elements and Machines*, J. Wiley
6. W. B. Green, Theory of Machine
7. R. L. Norton, *Design of Machinery*

HEATING, VENTILATION AND AIR CONDITIONING (BME-365)

Contact Hours:	**Credit Hours:**
Theory = 48	**Theory = 3.0**
Practical = 48	**Practical = 1.0**
Total = 96	**Total = 4.0**

COURSE LEARNING OUTCOME (CLOS)

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO

1.	**Apply** the fundamental concepts in the selection of various components (evaporator, condensers etc.) of refrigeration and HVAC systems.	Cognitive	3	1
2.	**Aanalyse** the factors affecting thermal comfort in AC zones and air treatment/handling requirements for public buildings	Cognitive	4	7
3.	**Propose** heating and cooling load for various structures/buildings	Cognitive	5	3

COURSE OUTLINE:

1. Pure substance properties:

a. Important properties of saturated and superheated vapours
b. Properties of liquid-vapour mixtures

2. Refrigeration system basics:

a. basics of vapour compression system
b. Pressure-enthalpy chart
c. coefficient of Performance
d. Cycle diagrams and the simple saturated cycle
e. Single stage and multi-stage compression cycle
f. Steam jet refrigeration cycle
g. Air refrigeration cycle

3.Refrigeration system analysis:

a. vapor absorption refrigeration cycle
b. Comparison of actual and theoretical refrigeration cycle
c. Heat pump
d. Types and properties of refrigerants
e. Condensers and evaporators
f. Compressors, Refrigerant flow control devices

4.Refrigeration load estimation (Refrigeration)

a. Product load
b. Air Change load
c. Heat gain through walls
d. Internal heat gain

5. Psychrometric properties of air:

a. Composition of air
b. Dalton's Law of partial pressure
c. Dew point temperature

d. Dry bulb and wet bulb temperatures
e. Psychrometric charts
f. Heating and humidification
g. Cooling and dehumidification

6.**HVAC basics,**

a. Thermal Comfort and Indoor environment Health
b. Water and vapour mixture
c. Air ventilation
d. calculation of fresh air supply of a building
e. air handling unit for untreated fresh air
f. Forced convection based air ventilator design
g. Air treatment fundamentals
h. indoor air quality

7.HVAC systems:

a. Essential components design of central air-conditioning plant
b. Water chiller and water heater
c. Air handling unit
d. Chilled water and hot water recirculation system
e. All-air systems basics
f. Single zone and reheat system
g. Variable Volume
h. Dual duct and multi-zone system

8.Heating and Cooling Load:

a. Space heating and cooling load
b. Design conditions
c. Transmission heat losses
d. Infiltration, ventilation and other heat loss and gain sources
e. Thermal radiation
f. Solar irradiation
g. Heat gain through fenestrations
h. Design conditions
i. Internal heat gain

8.Pressure loss, Duct design and Air flow balancing

Teaching Methodology:

- Lecturing
- Written Assignments
- Field Visits
- Report Writing

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS:

1. McQuiston, Parker and Spitler, *Heating, Ventilating, and Air-Conditioning Analysis and Design*, John Wiley & Sons
2. W. F. Stoecker ,*Refrigeration and Air Conditioning*
3. Ed. Kreider, Curtiss &Rabl, *Heating and Cooling of Buildings* ,McGraw-Hill
4. Dossat, R. J., John Wiley, Principles of Refrigeration.
5. Haines, Roger W. Wilson, Lewis, *HVAC Systems Design Handbook*, McGraw-Hill Companies
6. Dincer, Ibrahim, Ratlamwala, Tahir Abdul Hussain ,*Integrated Absorption Refrigeration Systems, Comparative Energy and Exergy Analyses*, Springer
7. *ASHRAE Fundamentals Handbook*
8. Shan K. Wang, *Handbook of Air Conditioning and Refrigeration*.

COURSE OUTLINE(Lab):

Experiments related to the Heat Transfer lab will be covered.

Teaching Methodology

- Demonstration
- Lab Report Writing

Assessment: Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

TEXT AND REFERENCE BOOKS:

Lab Manual

INSTRUMENTATION, MEASUREMENT & QUALITY CONTROL (BME-366)

Contact Hours:	**Credit Hours:**
Theory = 32	Theory = **2.0**
Practical = 48	Practical = 1.0
Total = 80	Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Understand** the basic concepts of measurement and quality control.	Cognitive	1	1

2	**Explain** the construction, working and applications of various sensors and gauges.	Cognitive	2	1
3	**Analyze** the measured data.	Cognitive	4	2
4	**Operate** data acquisition devices according to the provided instructions during experimentation.	Psychomotor	3	5

COURSE OUTLINE(Theory):

- **Introduction to measurement and instrumentation**. Significance of measurement, planning of experiments, general measurement system, calibration
- **Static and dynamic characteristics of instruments**: measurement sensitivity, range, accuracy, precision, repeatability, and uncertainty of instruments, measurement errors
- **Measurement** of length, displacement, force, torque, strain, frequency, pressure, flow, and temperature.
- **Introduction to data acquisition systems**, signal conditioning, display elements.
- **Quality Control,** Good and services, Product design, Industry standards, Procedural documentation, Product assembly.

Assessment

Mid Term, Quizzes, Assignments, Final Term

TEXT AND REFERENCE BOOKS:

1. E. Doeblin, *Measurement Systems Applications and Design*, McGraw Hill

2. D. G. Alciatore, M. B. Histand, *Introduction to Mechatronics and Measurement Systems*.

LAB OUTLINE:

Experiments related to the Instrumentation, Measurement & Quality Control will be covered in the Lab class.

Teaching Methodology

- Lecturing
- Written Assignments
- Lab. Reports

Course outline:

Experiments related to the Control Engineering will be covered.

Teaching Methodology

- Demonstration
- Lab Report Writing

Assessment Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books: Lab Manual

ENGINEERING ECONOMICS (BME-471)

Contact Hours:
Theory =32
Practical = 0.0
Total = 32

Credit Hours:
Theory = **2.0**
Practical = 0.0
Total = **2.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Understand** the basic knowledge of	Cognitive	2	1

	cost and taxation concepts			
2.	**Develop** the cash flow diagrams based on the time value of money	Cognitive	3	2
3.	S**olve** economics problems involving comparison and selection of alternatives by using variety of analytical techniques.	Cognitive	3	3

Course outline:

1. **Introduction**
    a. Engineering Costs
    b. Estimation Models & Cash Flow Diagram
    c. Life cycle cost

2. **Time value of Money**
    a. Time value of money, equivalence, use of spread sheet, simple and compound interest
    b. Uniform series & Arithmetic & geometric gradient
    c. Nominal & effective, continuous compounding Economic criteria,
    d. Present Worth, future worth and annuity

3. **Rate of Return**
    a. Minimum acceptable rate of return(MARR),
    b. Internal rate of return, External rate of return
    c. Choosing the best alternative
    d. Incremental Analysis

4. **Benefits and Cost ratio and Payback period**
    a. Benefit and cost ratio (B/C Ratio), discounted benefit and cost ratio
    b. Simple payback period, discounted payback period
    c. Sensitivity & breakeven analysis
    d. Principle of comparative advantage

5. **Depreciation**
    a. Depreciation
    b. Depreciation using Unit of Production
    c. Depreciation using straight line method
    d. Depreciation using Depletion

6. **Taxes**
    a. Income Taxes, After tax RoR
7. **Replacement analysis**
    a. Design life, salvage value
    b. Up gradation Vs replacement

Teaching Methodology

- Lecturing
- Written Assignments
- Presentation

Assessment

Mid Exam, Quizzes, Final Exam, Assignments, Presentations.

Text and Reference books:

1. William G. Sullivan and Elin M. Wicks, *Estimation of future events*
2. N. M. Fraser and E. M. Jewkes, *Engineering Economics: Financial Decision Making for Engineers*
3. D. G. Newnan, J. Whittaker, T. G. Eschenbach and J. P. Lavelle, *Engineering Economic Analysis*
4. A. J. Tarquin, L. T. Blank, *Engineering Economy*, McGraw Hill

MECHANICAL VIBRATIONS (BME-472)

Contact Hours:
Theory = 48
Practical = 48
Total = 96

Credit Hours:
Theory = **3.0**
Practical = 1**.0**
Total = **4.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Demonstrate** various techniques to mathematically model vibrating systems with one/two/multi degree of freedom.	Cognitive	3	1

2.	**ANALYZE** the physical parameters involved in natural frequency and system response to free, forced or impulse inputs.	Cognitive	4	2
3.	**CONSTRUCT** engineering structures and mechanical systems under dynamic conditions.	Cognitive	5	3
4.	**Investigate** the dynamic response of various systems under different conditions using experimental setups.	Psychomotor	3	4

COURSE OUTLINE (Theory):

1. **Introduction**
   a. Fundamentals of Vibrations, Degrees of Freedom
   b. Discrete and Continuous Systems, SHM, Vibration Analysis Procedure
2. **Single Degree of Freedom Systems - Free Vibratory Systems**
   a. Newton's Method, Energy Method
   b. Viscously Damped Free Vibration
   c. Logarithmic Decrement, Springs and dampers in Combination
3. **Single Degree of Freedom Systems – Forced Vibratory Systems**
   a. Forced Harmonic Vibration, Rotating Unbalance
   b. Base Excitation, Vibration Isolation, Energy Dissipation by Damping
   c. Whirling of Rotating shafts
4. **Transient Vibration**
   a. Impulse Response Function, Response to an Arbitrary Input
5. **Systems with Two Degrees of Freedom**
   a. The Normal Mode Analysis, Free Vibration Analysis of an Undamped Systems
   b. Coordinate Coupling, Free Vibration Analysis of Damped systems
   c. Forced Harmonic Vibration of an Undamped Systems
   d. Forced Harmonic Vibration of Damped Systems
6. **Multi Degree of Freedom Systems**
   a. Eigen Values and Eigen Vectors, Dunkerley's Method, Rayleigh's Method
   b. Influence co-efficients, Matrix Iteration Method
   c. Stodola's Method, Holzer's Method

Teaching Methodology

- Lecturing
- Tutorial sessions
- Discussions

Assessment

Quizzes, Mid Exams, Assignments, Term Project, Final Exam

TEXT AND REFERENCE BOOKS:

1. W T Thompson, *Mechanical Vibrations: Theory & Applications,* Prentice Hall. 5th ed, 1997
2. S S Rao, *Mechanical Vibrations,* 4th ed, Prentice Hall, 2003
3. L Meirovitch, *Elements Of Vibration Analysis,* 2nd ed, McGraw Hill, 1986
4. E Dimaogonas, *Vibration for Engineers,* 2nd ed, Prentice Hall, 1996

COURSE OUTLINE(Lab):

The experiments in the lab complement the knowledge gained in theory lectures.

Teaching Methodology

- Demonstration
- Lab Report Writing

Assessment

Lab performance, Quizzes, Lab Report, Lab Exams, Lab Assignments

TEXT AND REFERENCE BOOKS:

Lab Manual

INTERNAL COMBUSTION ENGINES (BME-473)

Contact Hours:
Theory =48
Practical = 0
Total = 48

Credit Hours:
Theory = **3.0**
Practical = **0.0**
Total = **3.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the basic knowledge, construction and working of various types of IC engines.	Cognitive	2	1

2.	**Apply** thermo-fluid calculations for the performance evaluation of IC engines.	Cognitive	3	1
3.	**Analyze** the effect of engine operating parameters (air/fuel ratio, ignition timing, fuel properties etc.) on engine performance.	Cognitive	4	2
4.	**Describe** the environmental effects of IC engine emissions.	Cognitive	2	7

COURSE OUTLINE

1. **Introduction to I.C engines:**
   a. History of I.C engine development
   b. Engine classifications
   c. Engine components and terminologies
   d. Working principle of turbo-charged, supercharged engine, its performance characteristics.
2. **SI & CI engines systems:**
   a. Basic engine cycle and operation
   b. Two and four stroke engines
   c. Engine operating characteristics (engine speed, compression ratio, sfc, A/F, F/A, etc)
   d. Engine parameters (efficiency, MEP, Power, torque, etc)
   e. Carburetors
   f. Fuel injectors
   g. Ignition system
   h. Electronic control unit, Engine management system
   i. Otto, Diesel and Dual cycle and their comparison
3. **Fuel and combustion:**
   a. Hydrocarbon fuels and their properties
   b. Thermochemistry and Chemical equilibrium
   c. Self-ignition and engine knock
   d. Ignition delay
   e. Octane and Cetane Numbers
4. **Gas exchange processes and mixture preparation:**
   a. Intake Manifold
   b. Volumetric efficiency
   c. Intake valves
   d. Variable valve Control
   e. Fuel injection, EFI systems (PFI, MPFI, GDI and Common-rail)
   f. Super-charging and turbo-charging
   g. Fluid Motion within combustion chamber
   h. Turbulence, Swirl, Squish and Tumble

i. Crevice Flow and blowby

5. **Combustion in SI and CI engines:**
   a. Ignition and flame development
   b. abnormal combustion and knock
   c. Spark timing and Maximum brake torque spark timing
   d. Diesel Fuel injection and mixture preparation
   e. Phases of combustion and ignition delay
   f. Injection timing, injection pressure
   g. common rail fuel injection
6. **Exhaust Flow:**
   a. Turbocharging
   b. Exhaust manifold
   c. Exhaust gas recirculation
7. **Pollution control,**
   a. engine emissions
   b. pollutant formation
   c. after treatment
   d. catalytic converters
   e. soot traps
8. **Heat Transfer in Engines** and engine cooling system
9. **Friction and Lubrication of engine,** Lubrication systems

Teaching Methodology:

- Lecturing
- Written Assignments
- Video showing components and operation of IC engine
- Assembling and dis-assembling of IC engines
- Field Visits
- Report Writing

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS:

1. W. W. Pulkrabek, *Engineering Fundamentals of IC engine*, Pearson Education Inc, USA
2. J. B. Heywood, *Internal Combustion Engine Fundamentals*, Heywood McGraw-Hill
3. Richard Stone Palgrave Macmillan, *Introduction to I. C. Engines*
4. C. F Taylor, *Internal combustion engines*. MIT Press.
5. R. V. Schäfer, F. Schäfer, *Internal Combustion Engine Handbook - Basics, Components, Systems, and Perspectives*, Fred SAE International.
6. C. R. Ferguson, *Internal Combustion Engines: Applied Thermo-sciences*, Wiley Science

INTRODUCTION TO FINITE ELEMENT ANALYSIS (BME-475)

Contact Hours:	**Credit Hours:**
Theory = 32	Theory = **2.0**
Practical = 48	Practical = 1.0
Total = 80	Total = 3**.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Explain** the fundamentals of FEA in engineering applications.	Cognitive	2	1
2.	**Solve** structural, thermal, dynamic and couple field problems using FEA.	Cognitive	3	2
3.	**Execute** systems by using FEA simulation techniques.	Psychomotor	4	5

COURSE OUTLINE:

1**. Introduction to FEA and Element Performance**

a. Introduction to Finite Element Modeling and preliminary decisions
b. Elements types and their properties
c. Basic concepts of equilibrium & compatibility
d. General factors affecting element performance – Sources of errors
e. Convergence.

2. FE Methods, Shape Functions, Stiffness Matrix and Transformation

a. Direct Stiffness Method, Energy Methods
b. Shape Function: Linear and Quadratic Element
c. Beam Elements, Truss Elements, Linear and Planar elements
d. Stiffness matrix, Local to Global Co-ordinate Transformation Assembly

3. Static Structural Analysis

- Modeling and analysis of 1D, 2D and 3D structures under static loading

4. Heat Transfer and Thermal Stress Analysis:

a. Introduction to Heat transfer, Thermal and Thermal Stress analysis concepts
b. Selection of Boundary Conditions based on the identification of problem
c. Thermal Analysis (Steady State)
d. Thermal stress Analysis

5. Dynamic Analysis

a. Introduction to different types of dynamic analysis
b. Modal Analysis, Frequency Response Analysis, Transient Response Analysis, Master Degrees of Freedom

Assessment

Mid Term, Quizzes, Assignments, Project, Final Exams

TEXT AND REFERENCE BOOKS:

1. Richard G. Budynass, *Advanced Strength and Applied Stress Analysis*, McGraw Hill
2. Saeed Moaveni, *Finite Element Analysis – Theory and Applications with ANSYS* , Prentice Hall
3. M J Fagan ,*Finite Element Analysis – Theory and Practice* ,Pearson Publications

Lab work:
FEA software based analysis may be conducted in the lab. Use software/tools like ANSYS and Solid Works etc.

Teaching Methodology

- Lecturing
- Written Assignments and projects (individual and as group)
- Report Writing

ANSYS, Solid Works and softwares are to be performed during lab.

Teaching Methodology

- Demonstration
- Software
- Lab Report Writing

Assessment

Lab performance, Projects, Quizzes, Lab Report, Lab Exams, Lab Assignments

Text and Reference books:

Lab Manual

FINAL YEAR PROJECT-I (BME-476)

Contact Hours:	**Credit Hours:**
Theory = 00	Theory = **0.0**
Practical = 144	Practical = 3.0
Total = 144	Total = 3**.0**

COURSE CONTENTS:
Students are required to select a design project. The project can be to solve a problem being faced in industry or it may be oriented towards designing a product. The project can also be motivated from a research problem taken from literature. At the end of 7th semester, students will have to submit a preliminary report of the project and have to clear a viva voce examination.

RECOMMENDED TEXTS:
As advised by the Project Supervisor

ENTREPRENEURSHIP (MSM-482)

Contact Hours:
Theory = 16
Practical = 0
Total = 16

Credit Hours:
Theory = **1.0**
Practical = 0.0
Total = **1.0**

COURSE LEARNING OUTCOMES:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Discuss** the fundamentals of entrepreneurship and its application.	Cognitive	2	1
2.	**APPLY** knowledge of entrepreneurship to different business plans as case studies.	Cognitive	3	1
4.	**Demonstrate** the role of entrepreneur individually and as team member during assignments and projects for different case studies.	Cognitive	3	9
5.	**Apply** management skills to an assigned entrepreneurship project.	Cognitive	3	11

Course outline:

1. Evolution of the concept of entrepreneur, Characteristics of an entrepreneur, Distinction between an entrepreneur and a Manager, in Economic Development, Factors affecting entrepreneurial growth (economic, Non-Economic and Government factors)
2. Critical factors for stalling a new enterprise. Ingredients for a successful new business. Self-assessment and feedback, Personal entrepreneurial competencies. Goal setting.
3. Creativity and sources of new business ideas, the difference the difference between ideas and opportunity and creativity. Assessing business opportunities in Pakistan. Screening and evaluating opportunities Product planning and development process. Creating parallel competition by developing a similar product or service, Product life cycle,

finding sponsorship. Acquiring a going concern, E-Commerce and business start-up and growth.

4. Marketing as a philosophy, marketing management: Creating a marketing plan, Analyze the environmental situation and the market opportunity, Setting marketing objective, formulating a marketing strategy.
5. The business plan as selling document, reasons for writing a business plan your company: What's your identity, Field work started, Marketing issues: Who are your buyers? Product issues: What are you selling?, Production exercise, Sales and Promotion: Financial issues: Targeting and writing the plan: Business Plan compilation exercise.
6. What is franchising? Becoming a franchisee versus starting a stand-alone business, The franchisee contract, Non-contractual considerations of buying a franchise, Limitations of franchising, Conclusion, Course evaluation.

Teaching Methodology

- Lecturing
- Written Assignments and projects (individual and as group)
- Report Writing

Assessment

Mid Term, Quizzes, Assignments, Project, Final Exams

TEXT AND REFERENCE BOOKS:

1. Rober D. Hisrich and Michael P. Peter, Entrepreneurs/lip,5th Edition, McGraw Hill
2. S.S. Khanka, Entrepreneurial Development
3. Irving Burstiner, The small Businesses Handbook
4. Bruce A. Kirchhoff, Entrepreneurship and Dynamic Capitalism
5. Modern Business Management, A System & Environment Approach by McGraw Hill
6. William D. Bygrave, The Portable MBA in Entreprenurs/lip Entrepreneurship CEFE, Germany, Development Manual

POWER PLANTS (BME-484)

Contact Hours:
Theory = 48
Practical = 48
Total = 96

Credit Hours:
Theory =3.0
Practical = 1.0
Total = 3.0

COURSE OUTCOME:

Upon successful completion of the course, the student will be able to:

S.No	CLO	Domain	Taxonomy level	PLO
1.	**Review** different energy resources, environmental impacts of power generation and flue gases.	Cognitive	2	7
2.	**Illustrate** the construction and operation of different components of a power plant.	Cognitive	3	2
3.	**Analyze** thermodynamically, different types of power plants.	Cognitive	4	2
4	**Design** major components and processes of a conventional or alternative energy power plant.	Cognitive	5	3

COURSE OUTLINE:

Introduction Review of mass and energy balances for steady flow devices, energy sources and classification; Fossil fuels; composition, ranking and analysis; combustion calculations; environmental pollution

Steam Generators and Turbines Combustion equipment and firing methods, boiler types and their applications; boiler components, boiler operation and safety, water treatment. Impulse and reaction turbines; Pressure and Velocity Compounding, Turbine governing and controls

Steam Powerplants Rankine Cycle, Superheat, Reheat; Regenerative Cycle, Open Type Feed Water Heaters (FWH), Closed Type FWHs with Drains Cascaded Backwards and Pumped Forward

Gas Turbine Powerplants Gas turbine (Brayton) cycle, regeneration, intercooling

Combined Cycle Powerplants Topping and bottoming cycles, combined cycle efficiency

Cogeneration Cogeneration of power and process heat, Back Pressure and Extraction Turbines

Diesel Engine Powerplant General layout, Site selection criterion, performance characteristics & environmental impact consideration

Nuclear Power Plant Nuclear fuels, nuclear reaction types, Components, reactor types, Site selection criterion, safety and environmental considerations

Renewable Energy Powerplants Introduction to Solar, Wind, Hydro and Geothermal Powerplants

Powerplant Economics and Management Effect of variable load, load curve, economics of thermal power plants, energy conservation and management

Teaching Methodology:

1. Lecturing
2. Written Assignments
3. Field Visits
4. Report Writing

Assessment:

Mid Exam, Final Exam, Quizzes, Assignments, Presentation

TEXT AND REFERENCE BOOKS:

1. Pedersen, E.S., *Nuclear Power, Ann Arbor Science*
2. El-Wakil, M.M., *Power Plant Technology*, McGraw-Hill
3. I. Dincer, C. Zamfirescu, *Advanced Power generation systems*, Elseveir
4. Larry Drbal, Pat Boston, "Powerplant Engineering", CBS Publishers
5. Black, Veatch, "*Power Plant Engineering*", Springer.
6. P.K. Nag, "*Power Plant Engineering*", McGraw-Hill.
7. Everett Woodruff, Herbert Lammers, Thomas Lammers, *"Steam Plant Operation"*, McGraw-Hill.
8. Thomas Elliott, Kao Chen, Robert Swanekamp, "*Standard Handbook of Powerplant Engineering*", McGraw-Hill.

FINAL YEAR PROJECT-II (BME-485)

Contact Hours: **Credit Hours:**

Theory = 00	Theory = **0.0**
Practical = 144	Practical = 3.0
Total = 144	Total = 3**.0**

COURSE CONTENTS:

Students will continue their work in the 8th semester. The final evaluation will be based on Project Report and viva voce.

RECOMMENDED TEXTS:

As advised by the Project Supervisor

ELECTIVE COURSES

Some of the technical and management electives are being suggested. However, the universities/DAIs may offer any other elective course keeping in view the faculty strength and availability. Interdisciplinary courses may be taken as elective courses.

TECHNICAL ELECTIVES

1. Renewable Energy Technology

Introduction to types of renewable energy, solar energy, wind energy, geothermal energy, ocean thermal energy, tidal wave and geothermal energy, biomass energy. Fuel cell and heat pump systems, energy efficiency issues and energy storage. Potential of using renewable energy resources as supplement of conventional energy resources.

Renewable and non-renewable energies used as hybrid energy systems, Modern renewable energy plants.

Wind energy, wind turbine design specifications, compatible electric generators and major operational issues of the wind mill for electric power generation. Wind mills design usage for pumping water.

Biomass energy conversion methods, detailed description of biomass energy conversion plant, operational and maintenance problems and their remedies.

Recommended Books:

1. G. Boyle, *Renewable Energy*, 2nd Edition, Oxford University Press.
2. J. Twidell, T. Weir, *Renewable Energy Resources*, Spon Press.

2. Gas Dynamics

Basic governing laws of conservation of mass, momentum and energy, limitations. Sub-sonic and supersonic gas flow. Mach number and Mach angle. Isentropic Flow and Applications; Operation of nozzles under varying pressure ratios. Normal and oblique shocks, Prandtl-Meyer compression and expansion with applications. Rayleigh flow and Fanno flow, Busemann's shock polar diagram.

Recommended Books

1. M. J. Zucrow and J.D. Hoffman, Gas Dynamics, John Wiley & Sons, 1976
2. A. H. Shapiro, R. Wiley, *The Dynamics and Thermodynamics of Compressible Fluid Flow*- Vol. 1, 1st Edition
3. J. E. John, Allyn and Bacon, *Gas Dynamics*, 2nd Edition
4. B.W. Imrie, *Compressible Flow*

3. Aerodynamics

Introduction, aerodynamics of incompressible flow, compressible and ideal fluid flow, aerofoil theory, finite wing aerodynamics, blade element theory and aircraft propellers, Cascade aerodynamics, jet propulsion, intake and nozzle performance, aircraft performance measurement.

Recommended Books

1. El. Houghton, A. E. Brock, St. Mortin, *Aerodynamics for Engineering Students*, Cambridge University Press, 2003
2. L. J. Clancy, Hallstead Pr., *Aerodynamics*

4. Computational Fluid Dynamics (CFD)

Types of ordinary and partial differential equations, solution of equation sets, boundary value and initial value problems, control volume approach, time stepping, accuracy, stability, consistency, linearization, diffusion, dispersion, vorticity stream function and primitive variable formulations. Turbulence modeling. Examples of external flow across various configuration, internal flows through pipes, ducts and valves.

Recommended Books:

1. J. D. Anderson Jr., *Computational Fluid Dynamics*, 1st Edition, McGraw-Hill Science

5. Maintenance Engineering

Introduction and types: Preventive maintenance, its objectives, benefits and economics, inspection and implementation. Routine maintenance and monitoring of fault indicators, main

concepts and implementation. Proper assembly/disassembly, alignment aspects, machine handling. Record keeping and maintenance scheduling, stocking spares and cost effectiveness, safety in maintenance. Basic repairs of electro-mechanical equipment, fault diagnosis and assessment. Introduction to predictive maintenance. Condition base monitoring.

Basic Repairs. Replacement/refurbishment of defectiveness parts e.g. bearings, brakes, shafts.

Recommended Books:

1. L. R. Higgins, L. C. Morrow, Maintenance Engineering Handbook, 3rd Edition, McGraw-Hill

2. B.J. Lewis, Management Handbook for Plant Engineers 2nd Edition, McGraw-Hill.

6. Introduction to Mechatronics

Sensors. transducers, transducer characteristics, sensors for measuring displacement, strain, force, pressure, temperature and motion.

Actuators. Motors and their types. Stepper motors. Permanent magnet DC motors. Servo Systems.

Interfacing. Ports, Input/Output, Analog to Digital converter, sampling theory, Digital to Analog converter. Sample and hold, multiplexer. Interfacing switches, LEDs, stepper motors and DC motors to micro-controllers.

Recommended Books

1. A. K. Stiffler, *Design with Microprocessors for Mechanical Engineers*, McGraw Hill 1992

2. Goankr, *Microprocessor Architecture, Programming and Applications*, 5th Edition, Prentice Hall

7. Automation and Robotics

Robotics: Basic concepts in robotics, classification and structure of robotic system, drive and control system, coordinate transformation, kinematics dynamic analysis and trajectory interpolation, interfacing with micro controllers and PLCs, applications of robots.

Robotics and Automated Guided Vehicles. Basic robot motion, path control, robot drive system sensors, robot-computer interface, robot programming, Automated Guided Vehicles (AGV) types.

Programmeable logic controller (PLC). Basics components and terminologies, ladder diagram elements, relay sequencing, processor input and output modules, programming unit and programming procedures with machines or assembly language.

Microcontroller. Basic elements of microcontroller, types of microcontroller, microprocessor and PLC, overview of architecture and principles of operations, assembly, machine and high level programming languages for microcontroller, input and output peripherals for specific application

in mechanical engineering with interfacing techniques. Actuators, sensor, input signals, output signals, signal conditioning.

Automations: Introduction to automations, automation strategies, economics of automations, partial automations, group technology and flexible manufacturing. Use of sensors and actuators in automations.

Recommended Books

1. Y. Korem, *Robotics for Engineers*, 1985
2. J. Craig, *Introduction to Robotics*, 3rd Edition, Prentice Hall
3. D. G. Alciatore, M. B. Histand, *Introduction to Mechatronics & Measurement Systems*, 2nd Edition, McGraw-Hill
4. C. D. Johnson, *Process Control Instrumentation Technology*, 7th Edition, Prentice Hall
5. C. R. Asfahd, *Robotics and Manufacturing Automation*, John Wiley & Sons
6. M. P. Groover, *Automation Production Systems*, 1987

8. Tribology

Friction, wear mechanism, wear debris classification, surface roughness, friction and wear measurement techniques, lubrication of sliding and rolling parts. Types of lubricants, grades and their properties; theories of lubrication, oil whirl, Hydrodynamic and elasto-hydrodynamics lubrication of journal bearing. Solid lubricants, self-lubricating fuel, tribology in manufacturing, tribology in automobiles.

Recommended Book

1. A Cameron, *Basic Lubrication Theory*,
2. D.D. Fuller, *Theory and Practice of Lubrication for Engineers*, John Wiley & Sons Inc. 1956
3. B. Bhushan, *Modern Tribology Handbook*, Vol-I, CRC Press, 2001

9. Nuclear Engineering

Review of nuclear physics, reactor physics, reactor heat transport. Types of nuclear reactors, and power plants. Reactor material . Nuclear fuels, enrichment and reprocessing; handling of fuels . Safety aspects.

Recommended Books

1. J.P. Lamarsh, *Introduction to Nuclear Engineering*, Prentice Hall 2001
2. M. M. El Wakil, *Nuclear Power Engineering*, McGraw-Hill 1962

10. **Mechanical Engineering Design**

Philosophy and concept of engineering design. Engineering creativity, phases and procedure in design. Management of engineering project. Computer aided design. Modeling and similitude, optimization and reliability. Application of industrial design codes.

Recommended Books

1. W. Eder, S. Hosnell, Design Engineering: A manual for enhanced creativity, CRC Press, 2007
2. A. H. Burr, J. B. Cheatham, Mechanical Analysis and Design, Prentice Hall.
3. D. G. Ullman, The mechanical design process, McGraw Hill.

11. Fluid Power: Hydraulics & Pneumatics

Specific Objectives of course:

- This course introduces the basic components and functions of hydraulic and pneumatic system.
- The objective is to understand the operation of a fluid power system with emphasis on the design and engineering of the system components

Course Outline:

Introduction to Fluid Power, Basic Principals of Hydraulics and pneumatics, Pumps, Hydraulic/pneumatic Circuits, Directional Control, Pressure Control, Hydraulic Flow Control, Ancillary Hydraulic Components.

RECOMMENDED BOOKS:

1. Johnson, James L. Introduction to Fluid Power. Hill.
2. Andrew Parr, Hydraulics and Pneumatics

MANAGEMENT ELECTIVES

1. Operations Management

Basics of managing manufacturing and service organizations; strategic decision making; facility location and layout; job design and work compensation; demand forecasting; capacity and material planning; scheduling in various environments; emerging trends in managing operations. Focus on selection and use of quantitative management tools after introducing fundamental concepts.

Recommended Books

1. W. J. Stevenson, *Operations Management*, 12th Edition 2015, McGraw Hill
2. A. Greasley, *Operations Management*, 3rd Edition, 2013,Wiley

2. Total Quality Management

Fundamental principles; Standards; Techniques for quality analysis and improvements; statistical methods and SPC. Acceptance sampling; QFD; Value engineering; Cross-functional management and benchmarking; ISO-9000 application, clauses, and implementation issues

Recommended Books

1. A. Rao, Lawrence P. Carr, I. Dambolena, R. J. Kopp, J. Martin, F. Rafii, P. Fineman Schlesinger, *Total Quality Management: A Cross Functional Perspective*, 1996, Wiley
2. S. Ramasamy, Total Quality Management, McGraw Hill Education, 2012

3. Project Management

Fundamental principles; Project life cycle; Project organization and human resource management; PM planning; Work breakdown structure; Estimating time and cost; Precedence relationships; Project scheduling and control techniques; Project risk analysis; Time compression and resource leveling; Computerized project management; special software packages

Recommended Books

1. Project Management - A Contemporary Approach, Darren Dalcher, WELEY, 2014
2. Managing High-Technology Programs and Projects, 3rd Edition, Russell D. Archibal, WILEY, 2003
3. Project Management, Gary R. Heerkens, PMP McGraw-Hill, 2002

4. Engineering Law

Introduction to legal studies, concepts and sources of law, basic principles of the law contract as it relates to engineers. The duty of care for engineers and the concept of negligence. Aspects of employment law. Intellectual property. Designs, patents, copyright in engineering. Enforcing rights to intellectual property.

Recommended Books:

1. *Abrahamson, Engineering Law and I.C.E. Contracts,* 4th Edition, Taylor & Francis
2. *C. F. Harding, Legal and Ethical Phases of Engineering*, McGraw Hill 1936
3. *F. Allen, Business Law for Engineers*
4. *A. R. Dick,* Engineering Law, 5th Edition, University Press

5. Operations Research

Operations research techniques and basics, Linear programming, graphical method, simplex method, geometric programming, dynamic programming, sensitivity and post-optimal analysis, transportation models, Queuing theory (weighting live models). Replacement Models. Simulation. basic principles, discrete models vs. continuous system simulation, applications, use of digital computer for simulation, languages of simulation, introduction to GPSS (General Purpose System Simulation) language, practical applications of GPSS.

1. **Recommended Books**
2. 1. H. A. Taha, *Operations Research***,** 7th Edition, Maxwell Macmillan International
3. 2. *J.A. Chisman, Introduction To Simulation Modeling Using GPSS/PC,* Prentice-Hall, 1992
4. 3. *M. Anderson, Lievano,* R.J. Kent, *Quantitative Management: An Introduction*, Publishing Co.