

**Ministry of Higher Education and Scientific Research**

**University of Diyala**

**College of Engineering**

**Mechanical Engineering Department**

**Curriculum for Mechanical Engineering Department**

**Vision**

The vision of the mechanical engineering department could be summarized in achieving leadership in mechanical engineering science and applications and mastering technology transfer for the benefit of the community and the world.

**Mission**

Achieving excellence in mechanical engineering education and scientific research in accordance with the requirements and standards of the Quality Management Office to achieve the satisfaction of all and continuous improvement and communication with all state institutions and departments and corresponding research centers and the local community to achieve the best service related to mechanical engineering.

**Program Educational Objectives:**

The graduates of the B.Sc. in Mechanical Engineering program will:

1. Engage in Mechanical Engineering profession in public and private sectors including, but not limited to, relevant governmental sectors, consulting firms, contracting companies, marketing and real estate investments;

2. Engage in ongoing professional development activities by pursuing graduate studies and / or other learning opportunities to respond to the arising challenges;

3. Advance in responsibility and leadership in their careers.

**Program Outcomes (ABET):**

a. An ability to apply knowledge of mathematics, science, and engineering.

b. An ability to design and conduct experiments, as well as to analyze and interpret data.

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

d. An ability to function on multidisciplinary teams

e. An ability to identify, formulate, and solve engineering problems f. An understanding of professional and ethical responsibility

g. An ability to communicate effectively

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

i. A recognition of the need for, and an ability to engage in life-long learning

j. A knowledge of contemporary issues

k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Mechanical Engineering Program: Mapping PO’s to PEO’s**

|  |  |  |  |
| --- | --- | --- | --- |
| Program Outcomes | Program Educational Objective | | |
|  | 1 | 2 | 3 |
| a | √ |  |  |
| b | √ |  |  |
| c | √ |  |  |
| d | √ | √ |  |
| e | √ |  |  |
| f | √ | √ | √ |
| g | √ |  |  |
| h | √ | √ |  |
| i | √ | √ |  |
| J | √ | √ | √ |
| k | √ |  | √ |

**Course descriptions**

Courses are coded as follows: 1. Course code and number

2. Course title

3. Parenthesized numerals, e.g., (4-3-1-3), indicate, in order, the credit hours, the classroom hours (1 hour = 1 credit hour), tutorial hours (credit hour = 0), and the laboratory hours (3 hour = 1 credit hour).

Prerequisites, if any, are indicated at the course description. These have been established to assure an adequate and uniform background for students in advanced classes. Occasionally, students may feel they already have the appropriate background for an advanced course because of previous training, transfer credits, or credit by examination.

**Course Numbering System**

Course code = ME

The number consists of letters followed by 3 digits

as following:

**100**: First year

**200**: Second year **300**: Third year

**400**: Fourth year

**U**: University Requirements

**E**: College Requirements,

**ME**: Department requirements

Numbers from 01, 02, 03, …….etc. describes the consequence of the course in each requirements.

1. ***Graduation Requirements***

|  |  |
| --- | --- |
| **Requirements** | **Credit hours** |
| University Requirements | 6 |
| College Requirements | 26 |
| Department Requirements | 105 |
| Department Elective Classes | 6 |
| **Total** | **143** |

1. ***University Requirements: 6 Credit Hours***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Cr. Hours** | **Weekly hours** | | |
| **Lec.** | **Tut.** | **Lab.** |
| U101 | Human Rights & Democracy | 1 | 1 | - | - |
| U102 | Computer Science | 2 | 1 | - | 2 |
| U103 | English Language | 2 | 2 | - | - |
| U104 | Arabic Language | 1 | 1 | - | - |
| **Total** | | **6** | **5** | **-** | **2** |
| **7** | | |

1. **College Requirements: 26 Credit Hours**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Course Code** | **Course Title** | **Cr. Hours** | **Weekly hours** | | |
| **Lec.** | **Tut.** | **Lab.** |
| 1 | E101 | Mathematics I | 3 | 3 | 1 | - |
| 2 | E102 | Mathematics II | 3 | 3 | 1 | - |
| 3 | E103 | Physics | 2 | 2 | - | - |
| 4 | E104 | Engineering Drawing I | 1 |  | - | 3 |
| 5 | E105 | Engineering Drawing II | 1 |  | - | 3 |
| 6 | E106 | Workshop Skills I | 1 |  | - | 3 |
| 7 | E107 | Workshop Skills II | 1 |  | - | 3 |
| 8 | E108 | Programming | 2 | 1 | - | 2 |
|  |  | **TOTAL for 1st Year** | **14** | **9** | **2** | **14** |
| 9 | E201 | Applied Mathematics I | 3 | 3 | 1 | - |
| 10 | E202 | Applied Mathematics II | 3 | 3 | 1 | - |
|  |  | **TOTAL for 2nd Year** | **6** | **6** | **2** | **-** |
|  |  | **TOTAL for 3rd Year** | **0** | **0** | **-** | **-** |
| 11 | E401 | Engineering Profession Ethics | 2 | 2 | - | - |
| 12 | E402 | Eng. Graduation Project I | 1 | - | - | 2 |
| 13 | E403 | Eng. Graduation Project II | 1 | - | - | 2 |
| 14 | E404 | Engineering Economy | 2 | 2 | - | - |
|  |  | **TOTAL for 4th Year** | **6** | **4** | **-** | **4** |
|  | **Total** | | **26** | **21** | **4** | **18** |
| **43** | | |

1. **Department Requirements: 105 Credit Hours**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course** **No.** | **Course** **Title** | **Cr.** **Hours** | **Weekly** **hours** | | |
| **Lec.** | **Tut.** | **Lab.** |
| ME107 | Chemistry | 3 | 3 | --- | --- |
| ME101 | Principles of manufacturing process | 2 | 2 | 1 | --- |
| ME103 | Electric Circuits | 3 | 2 | 1 | 2 |
| ME106 | Statics | 5 | 5 | 1 | --- |
| ME201 | Strength of Materials | 5 | 5 | 1 | --- |
| ME202 | Fluid Mechanics I | 4 | 4 | 1 | --- |
| ME204 | Engineering of Metallurgy | 3 | 3 | 1 | --- |
| ME212 | Electrical Machines | 3 | 3 | 1 | --- |
| ME205 | Lab. 2A | 1 | --- | --- | 3 |
| ME207 | Dynamics | 4 | 4 | 1 | --- |
| ME206 | Applied Computer Programming | 2 | 1 | --- | 2 |
| ME208 | Mechanical Drawing and CAD | 2 | --- | --- | 6 |
| ME210 | Thermodynamics | 4 | 4 | 1 | --- |
| ME211 | Lab. 2B | 1 | --- | --- | 2 |
| ME301 | Mechanics of Machines | 4 | 4 | 1 | --- |
| ME306 | Internal Combustion Engines | 4 | 4 | 1 | --- |
| ME303 | Engineering Analysis | 2 | 2 | 1 | --- |
| ME302 | Engineering Statistics | 3 | 3 | --- | --- |
| ME304 | Fluid Mechanics II | 4 | 4 | 1 | --- |
| ME305 | Lab. 3A | 1 | --- | --- | 3 |
| ME307 | Engineering Numerical Methods | 3 | 2 | 1 | 2 |
| ME308 | Manufacturing Process | 4 | 4 | 1 | --- |
| ME313 | Operations Research | 3 | 3 | --- | --- |
| ME311 | Heat Transfer | 4 | 4 | 1 | --- |
| ME310 | Engineering Materials | 3 | 3 | 1 | --- |
| ME314 | Lab. 3B | 1 | --- | --- | 2 |
| ME401 | Design of Machine Elements I | 3 | 3 | 1 | --- |
| ME402 | Control Engineering | 4 | 4 | 1 | --- |
| ME403 | Industrial Engineering | 2 | 2 | 1 | --- |
| ME404 | Mechanical Vibrations | 4 | 4 | 1 | --- |
| ME405 | Air conditioning | 5 | 5 | 1 | --- |
| ME408 | Lab. 4A | 1 | --- | --- | 3 |
| ME409 | Design of Machine Elements II | 3 | 3 | 1 | --- |
| ME411 | CAE | 2 | 1 | --- | 2 |
| ME407 | Power Plant | 2 | 2 | 1 | --- |
| ME412 | Lab. 4B | 1 | --- | --- | 3 |
|  | **Total** | **105** | **93** | **24** | **30** |

**5 ME** **Selective** **classes**

|  |  |  |  |
| --- | --- | --- | --- |
| **Course** **No** | **Course** **Title** | **Cr.** **Hours** | **Weekly** **hours** |
| ME421 | Fracture Mechanics | 3 | 3 |
| ME429 | Finite element method | 3 | 3 |
| ME423 | Solar energy | 3 | 3 |
| ME424 | Aerodynamics | 3 | 3 |
| ME425 | Refrigeration engineering | 3 | 3 |
| ME426 | Corrosion engineering | 3 | 3 |
| ME427 | Failure analysis | 3 | 3 |
| ME428 | Mechanics of composite materials | 3 | 3 |

**First Year**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course No.** | **First Semester** | | | | | **Course No.** | **Second Semester** | | | | |
| **Course Title** | **Credit** | **Weekly hours** | | | **Course Title** | **Credit** | **Weekly hours** | | |
| **Lec.** | **Tut.** | **Lab.** | **Lec.** | **Tut.** | **Lab.** |
| **E101** | **Mathematics1** | **3** | **3** | **1** | **---** | **E102** | **Mathematics1I** | **3** | **3** | **1** | **---** |
| **E103** | **Physics** | **2** | **2** | **---** | **---** | **E108** | **Programming** | **2** | **1** | **---** | **2** |
| **E104** | **Engineering Drawing I** | **1** | **---** | **---** | **3** | **E105** | **Engineering Drawing II** | **1** | **---** | **---** | **3** |
| **E106** | **Workshop Skills I** | **1** | **---** | **---** | **3** | **E107** | **Workshop Skills II** | **1** | **---** | **---** | **3** |
| **U101** | **Human Rights & Democracy** | **1** | **1** | **---** | **---** | **ME101** | **Principles of Manufacturing Process** | **2** | **2** | **1** | **---** |
| **ME107** | **Chemistry** | **3** | **3** | **---** | **---** | **ME103** | **Electric Circuits** | **3** | **2** | **1** | **2** |
| **U102** | **Computer Science** | **2** | **1** | **---** | **2** | **ME106** | **Statics** | **5** | **5** | **1** | **---** |
| **U103** | **English Language** | **2** | **2** | **---** | **---** | **U104** | **Arabic Language** | **1** | **1** | **---** | **---** |
|  | **Total** | 15 | 12 | 1 | 8 |  | **Total** | 18 | 14 | 4 | 10 |

**Second Year**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course No.** | **First Semester** | | | | | **Course No.** | **Second Semester** | | | | |
| **Course Title** | **Credit** | **Weekly hours** | | | **Course Title** | **Credit** | **Weekly hours** | | |
| **Lec.** | **Tut.** | **Lab.** | **Lec.** | **Tut.** | **Lab.** |
| **ME201** | **Strength of Materials** | **5** | **5** | **1** | **---** | **ME207** | **Dynamics** | **4** | **4** | **1** | **---** |
| **E201** | **Applied Mathematics 1** | **3** | **3** | **1** | **---** | **ME212** | **Electrical Machines** | **3** | **3** | **1** | **---** |
| **ME202** | **Fluid Mechanics I** | **4** | **4** | **1** | **---** | **E202** | **Applied Mathematics 1I** | **3** | **3** | **1** | **---** |
| **ME204** | **Engineering of Metallurgy** | **3** | **3** | **1** | **---** | **ME208** | **Mechanical Drawing and CAD** | **2** | **---** | **---** | **6** |
| **ME206** | **Applied Computer Programming** | **2** | **1** | **---** | **2** | **ME210** | **Thermodynamics** | **4** | **4** | **1** | **---** |
| **ME205** | **Lab. 2A** | **1** | **---** | **---** | **3** | **ME211** | **Lab. 2B** | **1** | **---** | **---** | **2** |
|  | **Total** | 18 | 16 | 4 | 5 |  | **Total** | 17 | 14 | 4 | 8 |

**Third Year**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course No.** | **First Semester** | | | | | **Course No.** | **Second Semester** | | | | |
| **Course Title** | **Credit** | **Weekly hours** | | | **Course Title** | **Credit** | **Weekly hours** | | |
| **Lec.** | **Tut.** | **Lab.** | **Lec.** | **Tut.** | **Lab.** |
| **ME301** | **Mechanics of Machines** | **4** | **4** | **1** | **---** | **ME307** | **Engineering Numerical Methods** | **3** | **2** | **1** | **2** |
| **ME306** | **Internal Combustion Engines** | **4** | **4** | **1** | **---** | **ME308** | **Manufacturing Process** | **4** | **4** | **1** | **---** |
| **ME303** | **Engineering Analysis** | **2** | **2** | **1** | **---** | **ME313** | **Operations Research** | **3** | **3** | **---** | **---** |
| **ME302** | **Engineering Statistics** | **3** | **3** | **---** | **---** | **ME311** | **Heat Transfer** | **4** | **4** | **1** | **---** |
| **ME304** | **Fluid Mechanics II** | **4** | **4** | **1** | **---** | **ME310** | **Engineering Materials** | **3** | **3** | **1** | **---** |
| **ME305** | **Lab. 3A** | **1** | **---** | **---** | **3** | **ME314** | **Lab. 3B** | **1** | **---** | **---** | **2** |
|  | **Total** | 18 | 17 | 4 | 3 |  | **Total** | 18 | 16 | 4 | 4 |

**Fourth Year**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course No.** | **First Semester** | | | | | **Course No.** | **Second Semester** | | | | |
| **Course Title** | **Credit** | **Weekly hours** | | | **Course Title** | **Credit** | **Weekly hours** | | |
| **Lec.** | **Tut.** | **Lab.** | **Lec.** | **Tut.** | **Lab.** |
| **ME401** | **Design of Machine Elements I** | **3** | **3** | **1** | **---** | **ME409** | **Design of Machine Elements II** | **3** | **3** | **1** | **---** |
| **E404** | **Engineering Economy** | **2** | **2** | **---** | **---** | **ME402** | **Control Engineering** | **4** | **4** | **1** | **---** |
| **ME403** | **Industrial Engineering** | **2** | **2** | **1** | **---** | **ME411** | **CAE** | **2** | **1** | **---** | **2** |
| **ME404** | **Mechanical Vibrations** | **4** | **4** | **1** | **---** | **ME407** | **Power Plant** | **2** | **2** | **1** | **---** |
| **ME405** | **Air Conditioning** | **5** | **5** | **1** | **---** |  | **ME Elective Class** | **3** | **3** | **---** | **---** |
| **E402** | **Eng. Graduation Project I** | **1** | **---** | **---** | **2** |  | **ME Elective Class** | **3** | **3** | **---** | **---** |
| **ME408** | **Lab. 4A** | **1** | **---** | **---** | **3** | **E403** | **Eng. Graduation Project II** | **1** | **---** | **---** | **2** |
| **E401** | **Engineering Profession Ethics** | **2** | **2** | **---** | **---** | **ME412** | **Lab. 4B** | **1** | **---** | **---** | **3** |
|  | **Total** | 20 | 18 | 4 | 5 |  | **Total** | 19 | 16 | 3 | 7 |

**Total credit = 143 units**

**Course Number: U101**

**Course Name: Human Rights& Democracy**

**Credit hours: (1-1-0-0)**

**Pre-requisite: None**

**Course Contents:**

Introduces students to the philosophic and political background of the concept of human rights. Discusses important documents as part of the history of the development of human rights theories. Examines important issues in current political and ethical debates about human rights. Reviews core legal documents and the work of the most important governmental and nongovernmental institutions currently involved in human rights protection and promotion. Examines at least one current problem area in human rights protection.

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**Course Number: U102**

**Course Name: Computer Science**

**Credit hours: (2-1-0-2)**

**Pre-requisite: None**

**Course Contents:**

Introduction: MSDOS Operating System,Windows Operating System, creating new folder, selecting folders, finding folders or files copying and moving files and folders. How to start any program shut Down formatting floppy disk, scandisk, arranging icon, run, help, etc; Win Word, Excel and Power point: All facilities, Description of its features and use, the function of toolbars and menu items (File, Edit, View, Format, Tools. Computer Aided Programs/CAD.

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**Course Number: U103**

**Course Name: English**

**Credit hours: (2-2-0-0)**

**Pre-requisite: None**

**Course Contents: *(New English course recommended by the Ministry council )***

This course is designed to enable the students to achieve academic oral and written communication to the standard required at university level. The course integrates all the language skills with emphasis on writing, and it stimulates students’ imagination, and promotes personal expression. Students, in this course, are trained to apply critical thinking skills to a wide range of challenging subjects from diverse academic disciplines. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary, and getting involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings and use of the Blackboard Suite.

**Course Number: E101**

**Course Name: MATHMATICS I**

**Credit Hours: (3-3-1-0)**

**Pre-requisite: None.**

**Course Content:**

The Tangent and Velocity Problems, The Limit of a Function, Calculating Limits Using the Limit Laws, Continuity, Limits at Infinity, Horizontal Asymptote, Infinite Limits, Vertical Asymptotes, Derivatives and Rates of Change, The Derivative as a Function, Differentiation of Polynomials, The Product and Quotient Rules, Derivatives of Trigonometric Functions. The Chain Rule, Implicit Differentiation, Related Rates, Maximum and Minimum Values, The Mean Value Theorem, How Derivatives Affect the Shape of a Graph. Summary of Curve Sketching, Optimization Problems. Antiderivatives, Areas and Derivatives. The Definite Integral. The Fundamental Theorem of Calculus, The Indefinite Integral and Net Change Theorem. The Substitution Rule. Areas between Curves, Volumes. Volumes by Cylindrical Shells. Average Value of a Function, Exponential and Logarithmic Functions. Derivative and Integrals Involving Logarithmic Functions. Inverse Functions. Derivative and Integrals Involving Exp Functions, Derivative and Integrals Involving Inverse Trig Functions. Hyperbolic Functions and Hanging Cables. Indeterminate Forms and L’Hospital’s Rule.

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**Course Number: E102**

**Course Name: MATHMATICS II**

**Credit Hours: (3-3-1-0)**

**Pre-requisite: MATHMATICS I**

**Course Content:**

Review of inverse functions. Inverse trigonometric functions, The derivative of inverse trigonometric functions. Hyperbolic functions, Inverse hyperbolic functions and their derivatives. Integrals involving inverse trigonometric and inverse hyperbolic functions, Integration by Parts. Trigonometric Integrals, Trigonometric Substitution, Integrating Rational Functions by Partial Fractions, Types of Improper Integrals and Methods of Evaluation, Sequences and their limits, monotone sequences, Infinite series, The comparison, Ratio and Root tests, Alternating series, Conditional convergence. Maclaurin and Taylor series, and their approximation, Power series, Differentiating and Integrating Power series, Polar coordinates, Curves defined by parametric equations, Tangent lines and length for parametric and polar curves, Area in polar coordinates.

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**Course Number: E103**

**Course Name: Physics**

**Credit Hours: (2-2-0-0)**

**Pre-requisite: None**

**Course Content:**

Newtonian mechanics, and thermal Physics, with topics include: Physics and measurement, Vectors, kinematics and dynamics of motion of a single particle in one and two dimensions, work and energy, system of particles, linear momentum and collisions, kinematics and dynamics of rotational motion, equilibrium of rigid bodies, and elasticity, fluid static and fluid dynamics, oscillatory motion, wave motion, and temperature and thermal equilibrium., Waves, Temperature, Heat.

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**Course Number: E104**

**Course Name: Engineering Drawing I**

**Credit hours: (1-0-0-3)**

**Pre-requisite: None**

**Course Contents:** Introduction to engineering drawing and its uses as engineering language in industry dimensioning symbols and terms used in drawing, metric system, Types of Engineering Tools and Their Uses, Engineering Operations, names and dimensions of lines used in drawings. Projections, The Conclusion Projected third Projection Stereo. Isometric Projection. Drawing various types of geometrical patterns (Traeery), Various methods of drawing ellipses, various types of tangents., Drawing according to scale, drawing various views of an actual object, rejections of all views necessary for a given object, projection of views using first and third angle projection methods. Freehand sketching proper and reasonable proportion.

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**Course Number: E105**

**Course Name: Engineering Drawing II**

**Credit hours: (1-0-0-3)**

**Pre-requisite: None**

**Course Contents:**

The use of CAD in engineering drawing. Description of menu Bar and toolbars. Drawing Ellipse, Rectangle, line, Ray, Circle, point, Arc, ---------- etc.

CAD Mechanical/ Special features

The use of various layers. Drawing electrical symbols on simple architectural plans.

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**Course Number: E106**

**Course Name: Workshop Skills I**

**Credit Hours: (1-0-0-3)**

**Pre-requisite: None**

**Course Content:**

The workshop training program is designed to satisfy the following objectives

Teaching safety rules and regulations on-site in an industrial environment Proper use of working tools, instruments, and machines, Introducing basic workshop practices, production, labor, and time-requirements of workshop operations. The students are introduced to training programs in nine workshops: electrical wiring, welding, forging, fitting , turning and milling, carpentry, plumbing auto-mechanics, and casting. The student is to spend 6 hours of training in every workshop

**Course Number: E107**

**Course Name: Workshop Skills II**

**Credit Hours: (1-0-0-3)**

**Pre-requisite: None**

**Course Content:** The workshop training program is designed to satisfy the following

**Objectives:** Teaching safety rules and regulations on-site in an industrial environment Proper use of working tools, instruments, and machines, Introducing basic workshop practices, production, labor, and time-requirements of workshop operations. The students are introduced to training programs in nine workshops: electrical wiring, welding, forging, fitting , turning and milling, carpentry, plumbing auto-mechanics, and casting. The student is to spend 6 hours of training in every workshop

**Course Number: E108**

**Course Name: Programming**

**Credit hours: (2-1-0-2)**

**Pre-requisite: None**

**Course Contents:**

This coarse aims to teach students fundamentals of programming languages and to train them to write programs in on of the following programming languages; Fortran, C++, or Matlab. Topics covered are ; (i) Constants & variables. (ii) Input & output statement. (iii) Control statements.(if, switch ) (iv) Loops.(for ,while, do….while) (v)string processing (vi) Subscripted variables (one and two dimension array ) (vii) subprograms ( functions).(viii) files input output.

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***Second Year***

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**Course Number: E201**

**Course Name: Applied Mathematics I**

**Credit Hours: (3-3-1-0)**

**Pre-requisite: Mathematics II**

**Course Content:**

Rectangular Coordinate systems in 3-space, Vectors, Dot product, projections, Cross product, Parametric equations of a line, Planes in 3-space, Introduction to vector-valued functions. Calculus of vector-valued functions, Change of parameters, Arc Length, Unit Tangent, Normal and Binormal vectors, Curvature, Quadric Surfaces. Functions of two or more variables, Limits and continuity. Partial derivatives, Differentiability, Local Linearity. The Chain rule, Directional derivatives and gradients. Tangent planes and normal vectors, Maxima and minima of functions of two variables. Lagrange multipliers, Double integrals. Double integrals over non rectangular regions, Double integrals in polar coordinates, Triple integrals, Cylindrical and spherical coordinates, Triple integrals in cylindrical and Spherical coordinates

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**Course Number: E202**

**Course Name: Applied Mathematics II**

**Credit Hours: (3-3-1-0)**

**Pre-requisite: Applied Mathematics I**

**Course Content:**

First-Order Differential Equations: Initial-value problem. separable variables. Homogeneous equations. Exact equations. Li-near equations. Integrating factor. Bernoulli equation. Applications. Second-Order Differential Equations: Initial-value and Boundary-value problems. Linear differential operators. Reduction of order. Homogeneous equations with constant coefficients. Non-homogeneous equations. Method of undetermined coefficients. method of variation of parameters. Some nonlinear equations. Applications. Higher order Differential Equations. Laplace Transforms: Definitions. Properties. Inverse Laplace transforms. Solving initial value problems. Special functions: Heavy side unit step function. Convolution theorem. System of Linear Differential Equations: Definitions. Elimination method. Application of Linear Algebra. Homogeneous linear systems. Non-homogeneous linear systems. Solving systems by Laplace transforms. Series Solutions: Cauchy-Euler equation method. Solutions about ordinary points. Solutions about singular points. Method of Frobenius. Second Solutions and Logarithm terms. Partial Differential Equations: Some mathematical models. Fourier series solutions. Method of separation of variables. The D’Alembert solution of the wave equation

***Third Year: None***

***Fourth Year***

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**Course Number: E401**

**Course Name: Engineering Profession Ethics**

**Credit Hours: (2-2-0-0)**

**Pre-requisite: None**

**Course Content:** Introduction: Why Professional Ethics?, What Is A Profession?, Professions as Social Practices, Models Of Professionalism, The Business Model, The Professional Model, Types Of Ethics Or Morality, Responsibility in Engineering, Engineering Standards, Framing the Problems, Resolving Problems, The Social and Value Dimensions of Technology, Trust and Reliability, Risk and Liability in Engineering, Engineers in Organizations, Engineers and the Environment, Cases should be presented for use in conjunction with materials (over the world & local)

**Text Book: Engineering Ethics, Concepts And Cases**, *Charles E. Harris, Michael S. Pritchard, and Michael J. Rabins, 2009, 2005 Wadsworth, Cengage Learning, USA*

*ISBN-10: 0-495-50279-0*

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**Course Number: E402**

**Course Name: Eng. Graduation Project I**

**Credit hours: (1-0-0-2)**

**Pre-requisite: None**

**Course Contents:**

Analytical, design, experimental, or field work carried out in accordance with a preapproved project plan under the supervision of faculty member(s).

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**Course Number: E403**

**Course Name: Eng. Graduation Project II**

**Credit hours: (1-0-0-2)**

**Pre-requisite: None**

**Course Contents:**

Continuation of previous work-Analytical, design, experimental, or field work carried out in accordance with a preapproved project plan under the supervision of faculty member(s).

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**Course Number: E404**

**Course Name: Engineering Economy**

**Credit Hours: (2-2-0-0)**

**Pre-requisite: None**

**Course Content:**

Introduction: Investment Explained, Interest and Financial Mathematics. Simple interest. Compound interest. Graphical Conventions Single Payment, Uniform Series. Arithmetic Gradient Nominal and Effective Interest Rates Interest and Principal Separation, Present Worth Analysis. Present Worth Analysis. Investment in Bonds, Use computer software (MS Excel) to perform basic economical analyses Annual Worth Analysis, Rate of Return Analysis3, Analysis of Public Projects. The Benefit-Cost-Analysis Depreciation Methods, Depreciation Analysis using Computer software (MS Excel) Income Taxes. After tax analyses, Effects of Inflation, Loans Breakeven Analysis,

**DPARTMENT REQIURMENT**

**First Year**

**ME 101**- **Principles of manufacturing process-(2-2-1-0)**

***Course*** ***Description:***

Materials engineering, physical properties and mechanical testing mechanical, industrial safety, measuring instruments, allowances and excesses, the production of metallic materials (ferrous and non ferrous), manufacturing operations, basic - plumbing, composition, hot, cold forming, manufacturing processes Secondary - welding, arrived metals , powder technology, operating Absolutely.

***Recommended*** ***Textbook(s):***

1. Fundamentals of Modern Manufacturing by Groover

2. Manufacturing Engineering and Technology by Kalpakjian 3. Materials and Processes in Manufacturing by E.P Degarmo 4. Process and Materials of manufacture by F.A Lindberg.

***Prerequisites:*** NONE

***Course*** ***Topics:***

Engineering materials, introduction to entrepreneurship, manufacturing processes: casting, welding, forming, sheet metal, working and joining processes. Hand work and hand tools, concept of machining processes, turning, drilling milling, and grinding. Metrological concepts. Industrial safety. Laboratory experiments.

**Course Number: ME107**

**Course Name: Chemistry**

**Credit Hours: (3-3-0-0)**

**Pre-requisite: None**

**Course Content:**

Gases. Pressure. The Ideal Gas Equation. Gas Stoichiometry. Partial Pressures, The Nature of Energy and Types of Energy. Energy Changes in Chemical Reactions. Introduction to Thermodynamics. Enthalpy of Chemical Reactions. Calorimetry. Standard Enthalpy of Formation and Reaction, From Classical Physics to Quantum Theory. Bohr’s Theory of the Hydrogen Atom. Quantum Numbers, Atomic Orbitals. Electron Configuration. The Building-Up (Aufbau) Principle, Development of the Periodic Table. Periodic Classification of the Elements. Periodic Variation in Physical Properties. Ionization Energy. Electron Affinity, Lewis Dot Symbols. The Ionic Bond. The Covalent Bond. Electro negativity. Writing Lewis Structures. Formal Charge and Lewis Structures. The Concept of Resonance. Exceptions to the Octet Rule, Bond Energy, Molecular Geometry. Dipole Moment. Valence Bond Theory. Hybridization of Atomic Orbital's, Hybridization in Molecules Containing Double and Triple Bonds. Delocalized Molecular Orbital's

**ME103- Electric Circuits-(3-2-1-2)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

Electrical quantity, resistance (Ohm's law), series circuit (voltage divider rule), parallel circuit (current divider rule). series-parallel network. kirchoff's voltage law. kirchoff's current law. delta-star and star-delta conversions. Meshanaloysis (Maxwell) determinate. Super position theorem. Thevenin's theorem.

Norton's theorem. Maximum power transfer theorem. A.C. circuit. sinusoidal alternating wave form. general format for the sinusoidal voltage or current, phase relation. Response of basic R, L, and C elements to sinusoidal voltage or current. Complex numbers (rectangular and polar form). series A.C. circuit impedance and the phase diagram. Resonance. Power factor. Transistor (PNP)-(NPN). Diode (PN)

**Recommended** **Books**

1. Electric Circuits, Basic Electricity by Schaum’s Series 2. Electric Machinery Fundamentals by S. Chapman

3. Electrical Power Technology by Theodore Wildi

**ME106- Statics -(5-5-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

**Force** **System**. Force, rectangular components, moment, resultant couple (two and three dimensional systems).

**Equilibrium**. Mechanical systems, isolation and equilibrium conditions for two and three dimensional systems.

**Structures**. Plane trusses, method of joints, method of sections, frames. **Friction**. Types of friction, dry friction, application of friction.

**Center** **forms**. Center of gravity, moment of inertia of the space

***Recommended*** ***Textbook(s):***

R.C. Hibbeler, Engineering Mechanics: Statics, Prentice Hall, 12th ed., 2010.

***Prerequisites:***

Non

***Course*** ***Topics:***

Definition of vectors in 2D and 3D, Physical examples, Analytical and graphical vector additions and subtractions.

Scalar and vector products, Analytical methods and graphical interpretation.

Resultant and equivalence of 2D force system, Analytical and graphical solutions.

Definition of moments and couples, Couples in 2D and 3D systems, Force systems with couples.

Resultant and equivalence of 3D force system, Systems with couples Analytical solutions.

Concept of free body diagram (FBD), Equilibrium of rigid bodies, Equations of equilibrium in 2D and 3D space.

Distributed forces and center of gravity, Determination of Centroids, distributed forces and Centroids of a volume.

Coefficients of friction, friction law, solving systems with friction.

Definition and types of internal forces, getting internal force diagrams in beams and shafts.

Truss structures, various methods of structural analysis, method of sections and method of joints.

Classification of supports.

***Program*** ***and*** ***Course*** ***Outcome***

1. The students should be able to define and describe the following basic concepts in mechanics such as Space, Time, Mass, Force, Particle, Rigid body, Scalar, Vector, Free vector, Sliding vector, Fixed vector, and perform calculations on summation, Subtraction, Direction cosine, Magnitude, Component, Unit vector, Vector decomposition.

2. The students will be able describe and define the following components of Newton’s Laws: First law, Second law, Third law, Gravitation law.

3. The students should demonstrate an understanding of the following concepts relating to forces: Contact force, Body force, Concurrent force system, Resultant (Combination of a force system), Decomposition of a force (rectangular and non-rectangular), Using triangle law to obtain the resultant will create a couple because forces in rigid body, mechanics are sliding vectors, not free vectors.

4. The student will be able to apply the cross product concepts to determine moments.

5. The student will be able to calculate the resultants of forces and couples.

6. The students will learn the differences and similarities between 2D and 3D systems. Additionally, the students should understand what complications are arise in studying 3D systems, and what is done to deal with these complications

7. The student will be able to isolate a mechanical system using Free body diagrams

8. The student will be able to identify the statically indeterminate, statically determinate and redundant structure .

9. The student will be able to calculate the center of mass of a body, and apply the equations of equilibrium to solve relevant application problems. 10. The student will be able to draw shear force and bending moment diagrams.

11. The students will be able to design a load carrying structure using truss analysis

**Second Year**

**ME202- Fluid Mechanics-I-(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

Fundamental concepts. Properties of fluids. Fluid Statics. Momentum and energy equations, applications. Bernoulli equation, applications. Dimensional analysis and similitude. Introduction to viscous flows and boundary layers. Internal flows, laminar and turbulent flows. Head loss and friction factor. Flow over immersed bodies (external flow). Lift and drag.

***Recommended*** ***Textbook(s):***

Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley & Sons, 6th ed., 2009.

***Prerequisites:***

E 102, E103

**ME204- Engineering of Metallurgy -(3-3-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:*** **Structure** **of** **Metals:** Crystalline structure of metals

Grains and grain boundaries, Nucleation and dentritic growth, Influence of solidification conditions on structure and properties. Defection cast metals.

**Thermal** **Equilibrium** **Diagrams:**

Cooling curves, solid solution alloys, factors affecting solid solubility, solid state diffusion, Thermal Equilibrium diagrams of a binary alloy showing complete solid solubility, effect of cooling rate, the inverse lever rule.

Equilibrium diagram of a binary alloy showing in complete solubility in the solid state. Partial solubility in the solid state, intermediate phases. Allotropy of Iron.

**The** **Iron/** **Carbon** **phase** **diagram**

The effect of rapid cooling, the Eutectoid reaction, the Peritectic diagram, plain carbon steels, mechanical properties microstructures, classification of plain carbon steel and uses, relationship between carbon content, microstructures and mechanical properties. Effect of some elements (Manganese, Silicon, Sulphur, Phosphourst.

**Cast** **Iron:**

Microstructures and mechanical properties, white cast iron, gray cast iron, malleable cast iron, the production of malleable cast iron.

**Heat** **Treatment:**

Heat Treatment processes, stress relieving, Annealing, full annealing, incomplete annealing, Isothermal annealing, diffusin annealing (homogenizing) annealing of casting, spherioidosing, of cementite, Normalization, Hardening, Thermal treatment of steel and the use of schemes TTT. Hardening of hypoeutectoid steel, Hardening of hypereutectiod steel, Hardening of tool steel, Martempening, Austempering, heating media, heating rate and heating time, tempening, hardenability, surface steel treatment of steel, carburizing of steel, heat treatment after carburizing, nitriding, heat treatment of Al alloys.

***Recommended*** ***Textbook(s):***

1. Materials and Processes in Manufacturing by E.P Degarmo 2. Process and Materials of Manufacturing by Lindberg

***Prerequisites:***

ME101- Principles of manufacturing process

**ME205**- **Lab. 2A [Fluid, Strength, Metallurgy]-(1-0-0-3)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

Lab experiments for strength of materials, fluid mechanics, and metallurgy.

***Recommended*** ***Textbook(s):***

Laboratory Manual, Compiled by Instructor

***Prerequisites:***

Concurrent with ME201

Concurrent with ME202 Fluid Mechanics-1 Concurrent with ME204 Engineering of Metallurgy

**ME206**- **Applied** **Computer Programming-(2-1-0-2)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

This course aims to train students to develop computer programs for different applications. Course include advanced programming topics for the specific language that was given in first year (E108) such as; Advanced data types, structures and unions, advanced file operations, graphics and building simple GUI, Develop programs for solving selected problems in statics, fluid, and strength of materials.

***Prerequisites:***

E108- Computer programming

**ME207**- **Dynamics -(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

Fundamental concepts of kinematics and kinetics with application of particles and plane motion of rigid bodies, Rectilinear and curvilinear motion of particles. Newton’s second law, impulse and momentum methods, impact, Dynamics of systems of particles, Kinematics of rigid bodies. Plane motion of rigid bodies: Forces and accelerations

***Recommended*** ***Textbook(s):***

R.C. Hibbeler, Engineering Mechanics: Dynamics, Prentice Hall, 12th ed., 2010.

***Prerequisites:***

E 103 Physics

ME106 Statics

***Course*** ***Topics:***

1. Kinematics of particles: -Rectilinear motion

-Curvilinear motion

2. Kinetics of particles: Newton’s 2nd law

- Linear momentum and rate of change of linear momentum - Equation of motion and Dynamic equilibrium

- Angular momentum and rate of change of angular momentum

- Equation of motion in terms of radial and transverse components - Conservation of angular momentum

- Newton’s law of gravitation

3. Kinetics of particles: Energy and momentum methods - Principle of work and energy

- Power and efficiency

- Conservation of energy

- Principle of impulse and momentum - Direct and oblique impact 4.Kinematics of rigid bodies

- Translation

- Rotation about a fixed axis - General plane motion

5.Plane motion of rigid bodies: Forces and acceleration - Equation of motion for a rigid body

- Angular momentum of a rigid body in plane motion

- Plane motion of a rigid body. D’ Alembert’s principle Program and Course Outcomes:

1 Use rectangular, normal-tangential, and polar coordinate systems to describe the motion (kinematics) of a particle, system of particles, and rigid bodies.

2 Use Newton’s Second Law, Work-Energy, and Impulse-Momentum principles to determine the kinetics of particles, systems of particles, and rigid bodies.

3 Understand and solve introductory vibration problems.

4 In applying the above principles, continue to develop a systematic, orderly procedure for solving engineering problems and design mechanical device using their knowledge in Dynamics.

**ME208**- **Mechanical Drawing and CAD-(2-0-0-6)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

Isometric and pictorial projections of solids/machine parts, making of freehand sketches from solid objects and from orthographic projections. Sections of joints, screw thread systems, nuts and bolts, keys and cotter, coupling and simple bearings, pipe connections and engine details, preparation of assembly drawings.

Parasolid mechanical CAD software (such as Solidworks, inventor), 3d solid modeling of parts, assembly of several parts, drawing of assembly and parts.

***Recommended*** ***Textbook(s):***

Colin H Simmons, Manual of Engineering Drawing Second edition

***Prerequisites:***

E 105 E106

**ME201 – Strength of Materials-(5-5-1-0)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program.*

***Course*** ***Description:***

External forces and concept of stress. Stresses and strains, Axial loading and axial deformation, Hook’s law, Statically indeterminate members, Stresses due to temperature. Torsion. Internal forces in beams, pure bending. Transverse loading and shear stresses in beams and thin-walled pressure vessels, beam deflection. Multiaxial loading. Transformation of stresses and strains. Principal stresses and strains. Axially compressed members and buckling of columns.

***Recommended*** ***Textbook(s):***

R.C. Hibbeler, Mechanics of Materials, Prentice Hall, 7th ed., 2007.

***Prerequisites:*** ME106 Statics

***Course*** ***Topics:*** 1. Introduction 2. Equilibrium 3. Stresses

4. Strains

5. Mechanical Properties 6. Axial Load

7. Torsion 8. Flexure

9. Transverse Shear

10. Stress Transformation 11. Beam Design

12. Buckling of Columns

***Program*** ***and*** ***Course*** ***Outcomes:***

1. Understand concept of stress and strain.

2. Understand relation between stress and strain

3. Ability to identify and solve statically indeterminate problems 4. Ability to analyze and design circular shafts under torsion

5. Ability to analyze stress conditions in beams under general eccentric loading

6. Ability to determine shear stress and shear flow in beams under transverse loading

7. Ability to transform stress

**ME210**- **Thermodynamics-(4-4-1-0)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Basics** **of** **Thermodynamics.** The system, working substance, heat and work, state and properties, temperature scales, processes and cycles. PV diagram, Internal energy, specific heats. Ideal gas laws, equations of state, first law of thermodynamics, system and control volume concept. Application of conservation of energy principle to isobaric, isochoric, isothermal, adiabatic, isentropic and polytrophic processes. Second law of thermodynamics and its consequences, reversibility. Heat engines, thermal efficiency of reversible and irreversible engines, the Carnot cycle. Concept of entropy and its application to flow- and non-flow processes. Available and unavailable energy, isentropic process, enthalpy-entropy diagram.

**Physical** **Properties** **of** **Steam.** The formation of steam, the triple point, quality of steam, sub-cooled liquid, enthalpy of steam, steam tables, PV diagram for steam, the critical point, behavior of vapor in different thermodynamic processes.

**Air** **Standard** **Cycles**. Carnot, Otto, Diesel, Dual, Brayton, Ericsson, Stirling cycles and their applications.

**Vapor** **Cycles.** The reversed Carnot, regenerative, reheat and binary vapor, refrigeration system, Rankine, vapour compression and Stirling cycles

**Properties** **of** **Mixtures.** Application of Dalton’s law and the Gibbs Dalton law, volumetric analysis of gas mixtures, molar mixture and specific gas constants, specific heat Operation of a gas mixture, adiabatic mixture of perfect gases. Psychrometry.

**Boilers.** Working principles, classification and configuration of boilers. Boiler efficiencies.

**Steam** **Engines.** Classification and working principles. **Steam** **Nozzles** **and** **related** **flow** **equations**

**Steam** **Turbine.** Classification and working principles. Efficiency. **Compressors.** Classification and working principles, single stage and multistage compressors, intercooling, efficiencies, indicator diagrams, velocity diagrams. Comparison of performance

***Recommended*** ***Textbook(s):***

1. Fundamentals of Thermodynamics by Moran and Shapiro

2. Thermodynamics, An Engineering Approach by Y.A. Cengel and M.A. Boles

3. Fundamentals of Thermodynamics by Van Wylen and Sontagg.

***Prerequisites:*** NONE

***Course*** ***Topics:*** 1. Introduction

2. First law of thermodynamics

3. Second law of thermodynamics 4. Ideal gas Laws

5. Air Standard Cycles 6. Vapor Cycles

**ME212-Electrical Machines-(2-2-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Transformers. Voltage and current relationship of primary and secondary types of transformers, losses and efficiency.Generators and motors. Types, construction and characteristics. Motor starters. Testing and efficiency of machines. Electric power transmission, relays and circuit breakers, amplifiers, electrical measuring devices, practical: laboratory experiments in the previous subjects.

***Recommended*** ***Books***

1. Electric Circuits, Basic Electricity by Schaum’s Series 2. Electric Machinery Fundamentals by S. Chapman

3. Electrical Power Technology by Theodore Wildi

4. Electric Circuits, Basic Electricity by Schaum’s Series 5. Electric Machinery Fundamentals by S. Chapman

6. Electrical Power Technology by Theodore Wildi

***Prerequisites:*** ME 103

**ME211-Lab. 2B [Thermodynamics, Electric Machines]-(1-0-0-2)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

***Prerequisites:***

Concurrent with ME212 Concurrent with ME210

**Third Year**

**ME301-Mechanics of Machines-(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Friction between unlubricated surfaces, motion on inclined plane, screw threads and efficiency, friction of pivot, collar and conical bearings, cone, plate and centrifugal clutch, belts and rope drives, chains and sprockets, bands and shoe brakes. Dead weight and spring loaded governors, effort and power, sensitivity, controlling force and stability. Gyroscope, gyroscopic stabilization. Geometry of gears, conditions for transmission of constant velocity ratio, velocity of sliding, path of contact, arc of contact, interference, simple and compound gear trains, epicyclic trains, compound epicyclical trains, torque on gear trains. Theory and applications of dynamometers.

Dynamics of engine mechanism/slider-crank mechanism. Velocity and acceleration of piston, angular velocity, acceleration. Forces and couples transmitted in a direct acting engine, velocity and acceleration diagrams, turning moment diagram, fluctuation of energy and speed. Flywheels, valve diagrams and valve gears, steering gears. Types of cams and followers, motion for a given cam profile. Balancing of rotating and reciprocating masses, balancing of in-line engines, V-engines, radial engines, balancing machines.

***Recommended*** ***Textbook(s):***

1. Mechanism Design Vol. 1 by Erdman and Sanders. 2. Theory of Machines by J.E. Shigley

3. Design of Machinery by R. Norton

***Prerequisites:***

ME207 Dynamics

**ME308-Manufacturing Process-(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Forming** **&** **Shaping** **Processes** **and** **Equipment.** Rolling. Flat rolling, rolling mills, shapes rolling, production of seam less tubing and piping. Extrusion and Drawing. Hot and cold extrusion, Extrusion and drawing equipment, Hydrostatic extrusion. **Sheet** **Metal** **Forming.** Sheet metal characteristics, formability of sheet metals, bending sheet and plate, tube bending & forming, deep drawing, supper plastic forming, explosive forming, equipment for sheet metal forming.**Forming** **&** **Shaping** **Plastics** **&** **Composite** **Materials.** Extrusion, injection molding, blow molding, thermo-forming, processing elastomers, processing reinforcer plastics, manufacturing honeycomb material, processing metal matrix and ceramic matrix composites.**Joining** **Process** **&** **Equipment.** Fusion welding process: Oxy-fuel gas welding, arc welding, electrodes, thermite welding, electron beam welding. Solid State welding process: Cold welding, ultrasonic welding, friction welding, resistance welding. Weld quality weldability, weld design and process selection, brazing, soldering, adhesive bonding, joining plastics. **Jigs** **&** **Fixtures.** General design principle, elements of jig, locating devices and clamping devices.

**Metal** **Casting** **Process** **&** **Equipment.** Molding and molding sands, classification of foundry process, casting and its types, pattern and pattern making, core and core making, furnaces, crucibles, molding tools and foundry equipment. **Material** **Removal.** Machines of chips formation, types of chips produced, forces and pressures involved, surface finishing and integrity, machinability. Calculation of material removal rate.

**Cutting** **Tools.** Single point tool geometry, mill cutters, factors which affect tool life, tool life relationships, tool materials, types and properties of cutting fluids. **Machine** **Processes** **for** **Producing** **Various** **Shapes**. Milling operation, milling machines, planning and shaping, broaching and broaching machines, gear manufacturing by machining.

**Abrasive** **Machining** **&** **Finishing** **Operations.** Abrasive, bonded abrasives (grinding wheels), grinding process, grinding fluids, design considerations for grinding, ultrasonic machining. **Non** **Conventional** **Machining** **Process.** Machining, electrochemical, electrical – discharge machining, wire E D M. **Control** **of** **Machine** **Tools.** Machine tools control, numerical control system, sequence control, PLC, servo copying, Computerized Numerical Control.(CNC), adaptive control, programming for numerical control. **Computer** **Integrated** **Manufacturing** **System.** Manufacturing system, Computer Integrated Manufacturing (CIM),

Computer Aided Manufacturing (CAM), computer simulation of manufacturing process and system, group technology, Flexible Manufacturing System (FMS), Artificial Intelligence (AI), Cellular manufacturing. **Powder** **Metallurgy.** Production of metal powders, compaction, sintering, design considerations. **Surface** **Treatment,** **Coating** **and** **Cleaning.** Mechanical surface treatment and coating, painting and its testing, thermal spraying, vapor deposition, electroplating and electro forming, anodizing, hot dipping, surface texturing and cleaning. **Introduction** **to** **Process** **Planning**

***Recommended*** ***Books***

1. Fundamentals of Modern Manufacturing by Groover

2. Manufacturing Engineering and Technology by Kalpakjian 3. Materials and Processes in Manufacturing by E.P Degarmo

***Prerequisites:***

ME 101 Principles of manufacturing process

**ME303-Engineering Analysis-(2-2-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Laplace** **Transform**. Laplace transform of elementary functions; Laplace transform theorems, inverse Laplace transform, applications to the solutions of ordinary differential equations.

**Fourier** **Series.** Fourier theorem and coefficients in Fourier series, even and odd functions, complex form of Fourier series.

**Fourier** **Transform.**

**Applications** **in** **Solving** **Differential** **Equations.**

***Recommended*** ***Books***

1. Advanced Engineering Mathematics, by Erwin Kreyszig 2. Elements of Differential Equations, by Keplan. W.

3. Mathematical Methods, by S. M. Yousuf

***Prerequisites:***

ME202 Applied mathematics II

**ME304-Fluid Mechanics-II-(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

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, Prandtyl-Meyer compression and expansion with applications.

Flow in ducts with friction and heat transfer. *STEAM TURBINES*

**Review** **of** **relevant** **topics.**

**Steam** **Turbines**. Impulse and reaction turbines, Compounding, Classification of turbines, Internal losses, State point locus and reheat factor. **Combined** **Heat** **and** **Power** **Plants**. Extraction and back pressure turbines. Turbine performance and controls. Feed water heater, air pre-heater economizer, super-heater. Plant efficiencies and their improvement.

*GAS TURBINES*

**Review** **of** **relevant** **topics**

**Working** **Cycles:** Effect of pressures, temperatures, and component efficiency on fuel and air consumption and power of the simple plant. Inter-cooling, reheat and heat exchanger cycles. Industrial open and closed plant.

**Gas** **Turbine** **Cycles** **for** **Aircraft** **Propulsion.** Turboprop, Turbofan and Turbojet engines, influence of altitude and flight speed on performance. **Centrifugal** **Compressors**. Principle of operation. Work done and pressure rise. Compressibility effects. Non-dimensional quantities for plotting compressor characteristics. Axial Flow Turbine. Elementary theory, vortex theory, choice of blade profile, pitch and chord, estimation of stage performance, overall turbine performance. Prediction of performance of Simple Gas Turbines. Component characteristic, off design operation of single shaft turbine, equilibrium running of a gas generator, off design operation of free-turbine engine, jet engine.

**Recommended** **Books**

1. Gas Dynamics, by M.J. Zucrow and J.D. Hoffman, Wiley, 1976.

2. The Dynamics and Thermodynamics of Compressible Fluid Flow (Volume 1), by A.H. Shapiro, Ronald, 1953.

3. Power Plant Technology, by M.M. El Wakil

4. Steam Turbines Theory and Practice, by W.J. Keartin

***Prerequisites:***

ME202 Fluid Mechanics I

**ME302 – Engineering Statistics-(3-3-0-0)**

***Prerequisites:***

E202 **Applied Mathematics 1I**

***Course*** ***Topics:***

Introduction, Data Summary and Presentation, Probability: Addition rule, conditional probability, multiplication rule and Bayes Theorem, Discrete random variables. Probability mass function. Mean and variance of discrete random variables, Probability Distribution functions: Uniform, Binomial, Geometric and Negative Binomial, Hyper-geometric and Poisson Distribution, Continuous random variables. Probability Density functions, Normal Distribution. Approximation to Binomial and Poisson Distribution. Exponential distribution. Other continuous distributions, Joint probability function. Multiple discrete and continuous random variables, Covariance and correlation. Bivariate Normal Distribution. Linear combination of random variables. Functions of random variables, Parameter estimation. Properties of estimators. Method of Moments, Method of Maximum likelihood, Interval estimation. Inference on the mean of a population: variance known or unknown. Inference on the variance of a normal population, Hypothesis testing about the mean and Proportion: Small and Large Sample, Hypothesis testing: Two Populations,

**ME307 – Engineering Numerical methods-(3-2-1-2)**

***Prerequisites:***

E 202, ME 206

***Course*** ***Description:***

The numerical methods course involves solving engineering problems drawn from all fields of engineering. The numerical methods include: error analysis, roots of nonlinear algebraic equations, solution of linear and transcendental simultaneous equations, matrix and vector manipulation, curve fitting and interpolation, numerical integration and differentiation, solution of ordinary and partial differential equations.

Error Analysis, Roots, Solving system of linear equations, Curve Fitting, Polynomial Interpolation, Integration and differentiation, Ordinary differential equations

**ME305- Lab. 3A [Machines, Combustion, Fluid]-(1-0-0-3)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

 Lower pair Mechanism , Gears, Gear Train ,Brakes  SI engines , CI engines , Fuels

***Recommended*** ***Books***

Laboratory Manual, Compiled by Instructor

***Prerequisites:***

Concurrent with ME301 Concurrent with ME304

Concurrent with ME306

**ME306 - Internal Combustion Engines-(4-4-1-0)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Classification,** **configuration** **and** **working** **principles** **of** **IC** **Engines.** **Analysis** **of** **Intake** **and** **Exhaust.** Measurement of fuel and air consumption, volumetric efficiency, super-charging, effect of air-fuel ratio and compression ratio on engine power & efficiency, pumping work, effect of residual gases on intake temperature, injection of fuel, carburetors/fuel injector, ignition system development, exhaust gas analysis and air pollution, control of exhaust gas contents, energy emissions.

**Fuels** **and** **Combustion.** Gasoline characteristics, alcohol refining and octane & cetane rating, diesel fuel oil classification, gas turbine & jet fuel, additives, combustion equation, CNG. Theoretical flame temperature, reaction rate and flame propagation, methods of igniting fuel, auto ignition, knock and the engine variable detonation, combustion theories, ignition delay, chemical equilibrium and dissociation, energy charts for unburned air mixtures, stratified charge engine, combustion chamber requirement.

**Lubricants.** Engine lubrication systems, additives for lubricants.

**Engine** **Characteristics.** Valve timing, torque & mean effective pressure, comparison of real cycles with the ideal cycle, indicated power, brake power, specific fuel consumption, heat balance sheet, relation between indicated thermal efficiency and load, SI & CI engines comparison, speed and load control in SI & CI engine, high output engines, turbocharged engines

***Recommended*** ***Books***

1. Internal Combustion Engine Fundamentals by J.B. Heywood 2. Internal Combustion Engines by C.R. Ferguson

3. Introduction to I. C. Engines by Richard Stone

4. Internal Combustion Engine Fundamentals by J.B. Heywood 5. Internal Combustion Engines by C.R. Ferguson

6. Introduction to I. C. Engines by Richard Stone

***Prerequisites:***

ME210 Thermodynamics

**ME311-Heat Transfer-(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Introduction**. Fundamental equations, relation to thermodynamics. **Conduction**. Conduction through plane and composite walls, cylinders and spheres with and without heat generating sources, Generalized Thermal Resistance Networks, Critical Radius of Insulation, heat transfer from extended surfaces (Fin Equation, Fin Efficiency, Fin Effectiveness), Heat Conduction Equation in a Large Plane Wall, Heat Conduction Equation in a Long Cylinder, Heat Conduction Equation in a Sphere, transient condition, heat transfer by lumped capacity method. Transient Heat Conduction in Large Plane Walls, Long Cylinders, and Spheres with Spatial Effects.

**Convection** **&** **Radiation** **Heat** **Transfer**

The convection boundary layer, the velocity and thermal boundary layer in laminar and turbulent flow over a flat plate. Internal flow through pipes. Dimensionless numbers. Reynolds analysis, shear stress, friction coefficient for fully developed flow. Free and forced convection, empirical correlations.

**Radiation.**

Radiation intensity, its relation to emission, black body radiation, absorbtivity, reflectivity, transmissivity. Wien’s displacement law, the Stefan Boltzman law, Kirchoff’s law, the gray body, radiation exchange between surfaces, the view factor, black body radiation exchange, radiation exchange between gray bodies, infinite planes and cylinders. **Heat** **Exchangers.**

Types, the overall heat transfer co-efficient, log mean temperature difference, parallel flow and counter flow heat exchanger, multi pass and cross flow heat exchanger, the effective NTU relations.

**Boiling** **and** **Condensation.**

Boiling curve for pool boiling; condensation over vertical plates; empirical correlations

***Recommended*** ***Books***

1. Fundamentals of Heat and Mass Transfer by Incropera & Dewitt 2. Heat Transfer, A Practical Approach by Y.A. Cengel

3. Heat Transfer by J. P. Holman ***Prerequisites:***

ME 210 Thermodynamics

**ME310-Engineering Materials-(3-3-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Corrosion units, cell-potential, iron-hydrogen cell, electrode kmetic, half-cell reactions, polarization, activation and concentration polarization, stress corrosion, corrosion fatigue, corrosion environments, corrosion in gas.

Fracture toughness, Griffith energy criterion, crack tip stresses, stress mtensity factor, fatigue cyclic stresses, stress life behavior, S-N curves. Factor affecting fatigue life, stress-intensity relationship, safe-life predication.

Creep test, strain rate equations, parameter methods, stress-relaxation, creep with polymers, viscoelastic behavior, Maxwell model.

Aluminum and aluminum alloy, properties, classification Al and its alloys, copper alloys, types of copper, brass, bronzes, tin-bronze, Al-bronze, Si-bronze.

Magnetic properties, Magnetic field, types of Magnetic.

Polymer structures, hydrocarbon molecules, thermoplastic and thermosetting, diffusion. stress-strain behavior, visoelastic, fracture of polymers. semicrystalline, plastic, fibers, ceramic structure and properties, silicate ceramics, glasses and glass ceramic, clay products, cements, advanced ceramics. Fabrication and processing, powder pressing, tape casting. composites, large-particle composites, dispersion strengthened composite, matrix phase, polymer-matrix composites.

**Recommended** **Books**

1. Foundations of Materials Science and Engineering, by William F. smith & Javad Hashemi

2. Ceramic Science for Materials Technologist by T.J McCalm 3. Engineering with polymers by P.C. Powell

**ME313-Operations Research-(3-3-0-0)**

***Course*** ***Description:***

Introduction to Operations Research (OR), Introduction to Foundation mathematics and statistic,

Linear Programming (LP), LP and allocation of resources, LP definition, Linearity requirement, Maximization Then Minimization problems. Graphical LP Minimization solution, Introduction, Simplex method definition, formulating the Simplex model. Linear Programming – Simplex Method for Maximizing. Simplex maximizing example for similar limitations, Mixed limitations, Example containing mixed constraints, Minimization example for similar limitations. Sensitivity Analysis: Changes in Objective Function, Changes in RHS, The Transportation Model, Solution Methods, Feasible Solution: The Northwest Method, The Lowest Cost Method; Optimal Solution: The Stepping Stone Method, Modified; Distribution (MODI) Method.

**ME305-Lab3A-[Machines, I.C, Fluid II] (1-0-0-3)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

***Recommended*** ***Textbook(s):***

Laboratory Manual, Compiled by Instructor

*Prerequisites:*

Concurrent requirement with ME301 Concurrent requirement with ME304

Concurrent requirement with ME306

**Fourth Year**

**ME 401-Design of Machine Elements-1-(3-3-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Basic criteria of the performance and design of machine parts, determination of permissible and actual stresses, design of simple elements, design of keys, cotters, and couplings. Design of welded, riveted and bolted joints. Design of translation screws. Metal fits, tolerances, standards of fits & tolerances, e.g. ISO standards, surface finish.

**Recommended** **Books**

1. Mechanical Engineering Design by J.E. Shigley

2. Machine Design, An Integrated Approach by R L Norton

***Prerequisites:***

ME 201

**ME402-Control and Measurements-(4-4-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Basic** **Concepts.** System, control system, input, output, open-loop and closed loop control systems, elements of a general control system, examples of control system.

**Mathematical** **Modeling** **of** **Physical** **System.** Free body diagram and Newton’s law of motion, operational notation, grounded chair representation, series parallel laws, equations of motion for spring mass damper systems, levered system, rotational system, geared system, electrical components and R.L.C circuits, electrical analogies for mechanical systems, scale factors, thermal systems and fluid system. **Transfer** **Functions** **and** **Systems** **Response.** Review of Laplace transform, impulse, step and ramp functions, concept of transfer functions of common components, block diagram algebra, signal flow graphs, impulse, step, and ramp response of first and second order systems, characterization of response (time constant, gain, overshoot, rise time, setting time, steady state error, etc.) relation of system response to location of system poles and zeros.

**Stability** **of** **Control** **System.** Concept of stability, Routh Hurwitz criterion.

**Root** **locus** **Methods** **and** **its** **Use** **in** **Control** **System** **Design** **Introduction** **to** **Digital** **Control**

Significance of measurement, planning of experiments, general measurement system, calibration, static and dynamic measurement sensitivity, range, accuracy precision, repeatability, and uncertainty of instruments, measurement errors. Instruments for measurement of length, force, torque, frequency, pressure, flow and temperature. Introduction to data acquisition through computers. A/D and D/A converters.

**Recommended** **Books**

1. Automatic Control, by Francis H. Raven

2. Modern Control System, by Richard C. Dorf 3. Automatic Control Systems, by B. B. Kuo

4. Measurement Systems Applications and Design, by E. Doeblin, McGraw Hill 5. Theory and Design for Mechanical Measurements, by R. Figliola, And D. Beasley, John Wiley.

***Prerequisites:***

ME 303

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**ME 403-Industrial Engineering-(2-2-1-0)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:*** **Plant** **Management**

The production and services systems inputs and output, management concepts and history. Management systems Role & functions of management. Factors affecting industrial development, industrial development of Pakistan, organization structures & types. Productivity, basic concepts, classification, measurement and improvement. Role of work study, work measurement and work sampling.

Plant location criteria, equipment and utilities layout, types of layout. Material handling systems. Types of production, group technology, variety control, make or buy decisions. Demand forecasting, useful forecasting models, material requirement planning, capacity requirement planning MRP-II. Inventory models and Just in time (JIT) technique, production planning, scheduling problems & models, project management PERT-CPM, network scheduling, activity crashing and resource leveling.

**Economics**

**Types** **of** **Costs**. Direct, Indirect, Overheads, Fixed, Variable, Opportunity, Sunk. Cash flow diagrams, time value of money, discounted cash flows.

**Equivalence**. Present worth, annual equivalent costs, internal rate of return. Payback period. Project feasibility analysis.

**Types** **of** **investments**. Equity vs. debt financing.

**Depreciation** **accounting**. Straight line, declining balance and sum of year digits. Plant replacement analysis. Types of taxes. After tax economic analysis.

**Inflation** **and** **Economic** **Considerations.** Cost estimating methods. Project cost control. Financial management and accounting methods. Case studies in process industries.

**Human** **Resources** **Management.** Recruitment process, job evaluation, performance appraisal, non financial & financial incentives, training, labor relations & industrial safety. Company and industrial laws. **Recommended** **Books**

2. Engineering Economy by DeGarmo.

3. Engineering Economy by White (National Book Foundation)

4. Production & Operations Management by Evert E.Adam Jr and Ronald.

5. Analysis & Control of Production Systems by Elsayed & Boucher. 6. Production Management by Kieth & Loekyer.

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**ME404-Mechanical Vibration-(4-4-1-0)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Oscillatory** **motion.** Harmonic motion, periodic motion, vibration terminology.

**Free** **vibrations.** Equation of motion, energy method, viscously damped free vibration, logarithmic decrement, harmonically excited vibration, forced harmonic vibration, vibration isolation, vibration measuring instruments.

**Two** **degree** **of** **freedom** **system.** Normal modes of vibration, coordinate coupling, forced harmonic vibration, vibration absorber, vibration damper. Orthogonality.

**Vibration** **of** **Elastic** **Bodies.** Free and forced vibration of cables and uniform bars, free and forced lateral vibrations of simply supported thin beams, torsional vibration of circular shafts with single rotor and two rotors, critical speed of rotating shafts.

**Finding** **natural** **frequencies**: Rayliegh method and Holzer method. **Measurement** **of** **Vibrations.**

**Recommended** **Books**

1. Mechanical Vibrations : Theory & Applications by W.T. Thompson 2. Mechanical Vibrations by S. S. Rao.

***Prerequisites:***

E 202

**ME405-Air Conditioning-(5-5-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Introduction to air conditioning, air humidity, air mixing, heat transfer coefficient, temperature design, the units of heat load, heat lost buildings, ventilation, pregnancy, cooling, solar heat, ventilation, accounts Download the cooling, the interactions physical, air conditioning, fluid flow, low pressure, blowers, Psychometry, basic air conditioning processes, load calculation, systems of air conditionings, humidification & economics of system dehumidification, humidifiers, air distribution systems, insulation materials. Industrial air-conditioning.

**Recommended** **Books**

1. Refrigeration and Air Conditioning by : W.F. Stoecker & Jones

***Prerequisites:***

E 202

**E 402-Senior Project-1-(1-0-0-2)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Problem statement, design concept, simulation work concept, or field work carried out in accordance with project plan under the supervision of faculty member(s).

and hardware a preapproved

**Recommended** **Books** By Topics

**ME407-Power Plant-(2-2-1-0)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

**Steam** **Power** **Plants**. General layout of modern steam plants, steam generators, engines and auxiliary components, back pressure and passout turbines. Deviation of actual cycle from ideal cycle, losses in pipes, turbine, pump and condenser.

**Gas** **Turbine** **Power** **Plant.** Development and improvement on gas turbine, the practical gas turbine cycle, modification of the basic cycle. Isentropic efficiency of compressors and turbines, intercooling & reheating. Hydro process plants basic classification and efficiency.

**Jet** **Propulsion** **Plant.** Aircraft jet engine, efficiency and performance of turbojet plant, ram jet and pulse jet, subsonic and supersonic propulsion, performance of rocket vehicles, propellants and combustion, thrust chamber.

**Introduction** **to** **Hydel** **Power** **Plants.** Low and high-head power plants. **Nuclear** **Power** **Plants.** Introduction, nuclear reactions as energy sources, components of nuclear plants. Fissions process self sustaining chain reaction, moderators and reflectors. Classification of thermal reactor, instrumentation, nuclear hazards and safety practice.

**Introduction** **to** **Solar** **Power** **Plants** **and** **other** **emerging** **technologies.** **Comparison.** Comparison of steam, gas, hydel , jet and nuclear power plants with special reference to the availability of fuel for these plants. Economic Analysis of Power Plants. Plant selection and performance characteristics.

**Recommended** **Books**

1. Power Plant Technology by M. M. El Wakil 2. Power plant by F.T. Morse

3. Applied Thermodynamics for Engineering Technologist by T. D. Eastop & J Mc. Conkey

4. Power Plant Technology by M. M. El Wakil 5. Power plant by F.T. Morse

6. Applied Thermodynamics for Engineering Technologist by T. D. Eastop & J. Mc. Conkey

**ME408-Lab4A-(1-0-0-3)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

***Free*** ***Vibration*** ***,*** ***Forced*** ***Vibration,*** ***Multi*** ***degree*** ***freedom*** ***Sensible*** ***heat*** ***,*** ***Latent*** ***Heat*** ***,*** ***Air*** ***Condition*** ***System***

***Recommended*** ***Textbook(s):***

Laboratory Manual, Compiled by Instructor

***Prerequisites:***

Concurrent requirement with ME 404 Concurrent requirement with ME 405

**ME409-Design of Machine Elements-II-(3-3-1-0)** *Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Stress concentration. Design of spur, helical, bevel & worm gears, design of rolling contact bearings, design of journal bearings, design of mechanical springs, design of shafts.

.

**Recommended** **Books**

1. Mechanical Engineering Design by J.E. Shigley

2. Mechanical Design, An Integrated Approach by R L Norton 3. Design of Machine Elements by M.F. Spotts

***Prerequisites:***

ME 401-Design of Machine Elements-I

**ME 4311-Senior Project-2-(1-0-0-2)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

***Course*** ***Description:***

Problem statement, design concept, simulation work concept, or field work carried out in accordance with project plan under the supervision of faculty member(s).

and hardware a preapproved

**Recommended** **Books** By Topics

**ME 4312-Lab4B(Power plant ,ME2,ME3)-(1-0-0-3)**

*Designation* *as* *a* *‘required’* *or* *‘elective’* *course:*

*This* *is* *a* *required* *course* *for* *the* *Mechanical* *Engineering* *Program*

*Recommended* *Textbook(s):*

Laboratory Manual, Compiled by Instructor *Prerequisites:*

Concurrent requirement with ME Selective Class