# OBE Based Curriculum of BSc Mechanical Engineering Technology (BSc MET)

**Department of Mechanical Engineering**
**Faculty of Engineering and Technology**
**International Islamic University, H-10, Islamabad**
**(April, 2021)**

# Curriculum & OBE Committee BSc Engineering Technology (Mechanical)

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|---|---|
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# 1. Vision and Mission

## 1.1 Vision of the University

To provide every opportunity for an all-round and harmonious development of individuals and society and reconstruction of human thought in all its forms on the foundations of Islam in order to encourage and promote education, training the research in Islamic learning, social, natural, applied and communication sciences and other branches of learning to ensure the Muslim Ummah's ideological, moral, intellectual, social, economic and technological development in accordance with the values, ideals, principles and norms of Islam.

## 1.2 Mission of the University

To optimize integration and Islamization of the contemporary knowledge and human thought in international perspective through established institutions and academic endeavors to achieve excellence in all branches of knowledge.

## 1.3 Mission of the Department

BSc Mechanical Engineering Technology Program is committed to prepare competent mechanical engineers equipped with knowledge, skills and ethical values to address technical challenges.

# 2. General Rules

## 2.1 Introduction

The following regulations govern the Semester System of teaching and examination:

- The medium of instructions and examinations shall be English for all subjects except for Islamic Studies and Pakistan Studies where the medium of instructions and examinations may be either Urdu or English.
- The term "Academic Year" refers to the period of study at the university spanning over one calendar year period. Academic year is further divided into semesters.
- The term "Contact Hour" refers to a 60 minutes period of contact with the students.
- Theory period of 1 hour per week = 1 Credit Hour.
- One practical of 3 hours per week = 1 Credit Hour
- One-week Training @ 8 Hours Daily x 5days per week = 1 Credit Hour of Training
- The term "Pre-requisites" refers to subjects that must be successfully completed prior to registration in a subject

## 2.2 Degree Duration and Credit Hours

The minimum duration of the undergraduate degree program (Mechanical Engineering Technology) is four academic years. The maximum duration of the degree program is seven academic years.

The credit hours required for the award of degree are 136 credit hours for degree program with minimum duration of four academic years.

The credit hours shall be made up as follows:

**a)** Practical = 50%

**b)** Theory = 50%.

## 2.3 Semester Duration

There shall be two regular semesters: Fall and Spring semesters. Each semester will be of 16 to 18 weeks including examinations with at least 16 study weeks during the semester.

In case of any subject(s) having prerequisite subject(s), registration in the subject(s) will be allowed only if the prerequisite subject(s) has/have been completed successfully.

# 3. Subject and curriculum Classification

### 3.1 Type A-Theory Evaluation

In Type-A subjects, there shall be a mid- term examination of minimum one-hour duration and a comprehensive final examination of at least one-and-a-half-hour duration. The mid-term examinations shall carry up to 30% weightage and final examination will carry 50% weightage.

The teacher shall schedule additional assessment instruments such as quizzes, assignments, presentations, seminars, group discussions, field study reports etc. as specified in the syllabus or as determined by the teacher. These assessment instruments shall carry up to 30% weightage.

### 3.2 Type B-Practical Evaluation

In Type-B subjects, each Experiment, Drawing, Project or Assignment shall be considered as an independent assessment instrument. Cumulative performance in all independent assessment instruments shall form the basis for evaluating a student.

# 4. Credit Hours

### 4.1 Definitions

| Type | Credit Hours (CH) | Contact Hours |
|---|---|---|
| **Theory Period** | 1 | 01 Hour / 60 minutes - Teaching per week for a minimum of 14 weeks in a semester |
| **Lab Practical or Workshop** | 1 | 03 Hours - Lab work or workshop per week for a Minimum of 14 weeks in a semester |
| **Continuous Supervised Industrial / Field training** | 1 | 01-week Training @ (08 hrs. daily x 05 days/week= 40hrs/week for a minimum of 16 weeks in a semester |

### 4.2 Summary

| Semester | Credit Hours | |
|---|---|---|
| | **Theory** | **Practical** |
| **1st** | 09 | 6 |
| **2nd** | 11 | 6 |
| **3rd** | 11 | 6 |
| **4th** | 15 | 3 |
| **5th** | 13 | 5 |
| **6th** | 9 | 7 |
| **Summer** | 0 | 3 |
| **7th** | 0 | 16 |
| **8th** | 0 | 16 |
| **Total** | **68** | **68** |
| **Grand Total** | | **136** |

### 4.3 NTC Curriculum Fundamentals

Curriculum fundamentals of BSc Mechanical Engineering Technology (BSc MET) provided by NTC are as follows:

### 4.3.1 Duration of the Courses

| Type | Description |
|---|---|
| **Total Degree Duration** | ➢ Four (04) Calendars Years |
| **Total Number of Semester(s)** | ➢ Eight (08) |
| **Duration of One (1) Semester** | ➢ Sixteen (16) weeks of instructions.<br>➢ One (01) to two (02) weeks of examination. |
| **Number of Credit Hours per Semester** | ➢ 15 – 18 Credit Hours / semester. |
| **Total Number of Credit Hours in Degree** | ➢ 136 Credit Hours. |
| **Credit Hours** | ➢ One (01) Contact Hour per week for each Credit Hours of instructions/Theory<br>➢ Three (03 Contact Hours per week for each Credit of Laboratory work) |

### 4.3.2 Percentage of Technical/Core and Non-Technical/Allied Subjects

| Type | Percentage |
|---|---|
| **Technical Courses/Core Subjects** | **73%** |
| **Non-Technical Courses/Allied Subjects** | **27%** |

# 5. Program Educational Objectives (PEOs)

| PEO | Description | Domain |
|---|---|---|
| **1** | Employable graduates pursuing successful careers. | Engineering Technology Practice |
| **2** | Graduates serving industry and society through R & D, professional development and entrepreneurship. | Professional Growth |
| **3** | Graduates with leadership qualities having Islamic values, interpersonal and managerial skills. | Social Service |

# 6. Mapping of PEOs with Mission

| Mission | PEO-1 | PEO-2 | PEO-3 |
|---|---|---|---|
| Excellence in Higher Education | √ | | |
| Lifelong Learning | | √ | |
| Productive Career | | | √ |

# 7. Program Learning Outcomes (PLOs)

| PLO | Title | Description |
|---|---|---|
| 1 | **Engineering Technology (SA1)** | An ability to apply knowledge of mathematics, natural science, Engineering Technology fundamentals and Engineering Technology specialization to defined and applied Engineering Technology procedures, processes, systems or methodologies. |
| 2 | **Problems Analysis (SA2)** | An ability to Identify, formulate, research literature and analyze broadly-defined Engineering Technology problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization. |
| 3 | **Designs/Development of Solutions (SA3)** | An ability to design solutions for broadly- defined Engineering Technology problems and contribute to the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. |
| 4 | **Investigation (SA4)** | An ability to conduct investigations of broadly-defined problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions. |
| 5 | **Modern Tool Usage (SA5)** | An ability to Select and apply appropriate techniques, resources, and modern technology and IT tools, including prediction and modeling, to broadly-defined engineering Technology problems, with an understanding of the limitations. |
| 6 | **The Engineering Technologist and Society (SA6)** | An ability to demonstrate understanding of the societal, health, safely, legal and cultural issues and the consequent responsibilities relevant lo engineering Technology practice and solutions to broadly defined Engineering Technology problems. |
| 7 | **Environment and sustainability (SA7)** | i. An ability to understand and evaluate the sustainability and impact of engineering Technology work in the solution of broadly defined Engineering Technology problems in societal and environmental contexts. |

| | | |
|---|---|---|
| **8** | **Ethics (SA8)** | Understand and commit to professional ethics and responsibilities and norms of engineering Technology practice. |
| **9** | **Individual and Team Work (SA9)** | An ability to Function effectively as an individual, and as a member or leader in diverse learns. |
| **10** | **Communication (SA10)** | An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **11** | **Project Management (SA11)** | An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments. |
| **12** | **Lifelong Learning (SA12)** | An ability to recognize the need for, and have the ability to engage in independent and life-long learning in specialist Engineering Technologies. |

# 8. PEO and PLO Mapping

| | | Program Educational Objectives | | |
|---|---|---|---|---|
| | | **PEO-1** Engineering Technology Practice | **PEO-2** Professional Growth | **PEO-3** Social Service |
| Program Learning Objectives (PEOs) | **PLO-01:**Engineering Technology Knowledge | √ | | |
| | **PLO-02:** Problem Analysis | √ | | |
| | **PLO-03:** Design/Development of Solutions | √ | | |
| | **PLO-04:** Investigation | √ | | |
| | **PLO-05:** Modern Tool Usage | | √ | |
| | **PLO-06:** The Engineering Technologist and Society | | | √ |
| | **PLO-07:** Environment and Sustainability | | √ | |
| | **PLO-08:** Ethics | | | √ |
| | **PLO-09:** Individual and Team Work | | | √ |
| | **PLO-10:** Communication | | | √ |
| | **PLO-11:** Project Management | | | √ |
| | **PLO-12:** Life-long Learning | | √ | |

# 9. Bloom's Taxonomy

### 9.1 Cognitive Domain

| S. No. | Level (C-x) | Learner Action | Question Ques |
|---|---|---|---|
| **1** | **Remember (C-1)** | Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. | List, Define, Label, Identify, Name |
| **2** | **Understand (C-2)** | Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas. | Describe, Associate, Categorize, Summarize |
| **3** | **Apply (C-3)** | Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way. | Apply, Calculate, Illustrate, Solve |
| **4** | **Analyze (C-4)** | Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations. | Analyze, Compare, Separate, Order, Explain |
| **5** | **Evaluate (C-5)** | Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. | Combine, Modify, Rearrange, "What-if" |
| **6** | **Create (C-6)** | Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions. | Assess, Decide, Grade, Recommend, Explain, Judge |

**9.2 Psychomotor Domain**

| S. No. | Level (P-x) | Learner Action | Question Ques |
|---|---|---|---|
| **1** | **Perception (P-1)** | The process of becoming aware of objects, qualities, etc. by way of senses. Basic in situation-interpretation-action chain leading to motor activity. May include sensory stimulation, cue selection, translation. | Identify, Inspect, select, Choose, Associate |
| **2** | **Set (P-2)** | Readiness for a particular kind of action or experience. This readiness or preparatory adjustment may be mental, physical or emotional. | Adjust, Arrange, Identify, Perform |
| **3** | **Imitate (P-3)** | Overt behavioral act of an individual under guidance of an instructor, or following model or set criteria. May include imitation of another person, or trial and error until appropriate response obtained. | Adopt, Copy, Correct, Follow, Match |
| **4** | **Mechanism (P-4)** | Occurs when a learned response has become habitual. At this level the learner has achieved certain confidence and proficiency or performance. The act becomes part of his/her repertoire of possible responses to stimulus and demands of situations. | Assemble, Calibrate, Combine, Construct, Display |
| **5** | **Complex Overt Response (P-5)** | Overt Response Performance of a motor act that is considered complex because of movement pattern required. May include resolution of uncertainty, i.e., done without hesitation; and automatic performance, finely coordinated with great ease and muscle control. | Adjust, Mend, Assemble, Dismantle, Fix |
| **6** | **Adaptation (P-6)** | Altering motor activities to meet demands of problematic situations. | Alter, Change, Convert, Revise, Rearrange |
| **7** | **Origination (P-7)** | Creating new motor acts or ways of manipulating materials out of skills, abilities and understandings developed in the psychomotor area. | Arrange, Automate, Build, Originate, Invent, Initiate |

**9.3 Affective Domain**

| S. No. | Level (A-x) | Learner Action | Question Ques |
|---|---|---|---|
| **1** | **Receive (A-1)** | Being aware of or sensitive to the existence of certain ideas, material, or phenomena and being willing to tolerate them. | Accept, Locate, Do, Concentrate, Acknowledge, |
| **2** | **Respond (A-2)** | Committed in some small measure to the ideas, materials, or phenomena involved by actively responding to them (motivation). | Aid, Cite, Compile, Comply, Interpret, Help |
| **3** | **Value (A-3)** | Willing to be perceived by others as valuing certain ideas, materials, or phenomena. | Accept, Argue, Challenge, Criticize, Debate |
| **4** | **Organize/Conceptualize Value (A-4)** | Relates the value to those already held and brings it into a harmonious and internally consistent philosophy. | Develop, Adhere, Alter, Arrange, Build, Generalize, Defend |
| **5** | **Internalize/Characterize Values (A-5)** | Acts consistently in accordance with the values he or she has internalized. | Solve, Verify, Act, Discriminate, Revise |

# 10. Mapping of PLOs to Course CLOs

| Mapping of CLO'S and SA'S to curriculum | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester | Course Code | Course Title | Type of Course | SA1 | SA2 | SA3 | SA4 | SA5 | SA6 | SA7 | SA8 | SA9 | SA10 | SA11 | SA12 |
| | | | | Engineering Technology | Problem Analysis | Design / Development of Solutions | Investigation | Modern Tool Usage | The Engineer and Society | Environment and Sustainability | Ethics | Individual and Team Work | Communication | Project Management | Life Long Learning |
| 1 | MH-112 | Islamic Studies | T | | | | | | | | √ | | | | √ |
| | | Professional Ethics | T | | | | | | | | √ | | | | |
| | MS-113 | Applied Physics | T | √ | | | | | | | | | | | |
| | MS-113L | Applied Physics | L | | | | √ | | | | | √ | | | |
| | MS-123 | Applied Mathematics-I | T | √ | | | | | | | | | | | |
| | MS-133 | Applied Chemistry | T | | | | | | | √ | | | | | |
| | MS-133L | Applied Chemistry | L | | | | | | | | | | | | |
| | MS-143 | Introduction to Computer Fundamentals | T | √ | | | | | √ | | | | | | |
| | MS-143L | Introduction to Computer Fundamentals | L | | | | | √ | | | | | | | |
| | MT-113L | Workshop Technology | L | √ | | √ | | √ | | | | | | | |
| `2 | MS-153 | Applied Mathematics-II | T | √ | | | | | | | | | | | |
| | MH-122 | Pakistan Studies | T | | | | | | √ | | | | | | |
| | MT-124 | Technical Drawing and CAD-I | T | √ | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MT-124L | Technical Drawing and CAD-I | L | √ | | | | √ | | | | √ | | | | |
| | MT-134 | Applied Thermodynamics-I | T | √ | | | | | | | | | | | | |
| | MT-134L | Applied Thermodynamics-I | L | | | | √ | | | | | √ | | | | |
| | MT-144 | Basic Electrical & Electronics | T | √ | | | | | | | | | | | | |
| | MT-144L | Basic Electrical & Electronics | L | | | | √ | | | | | √ | | | | |
| 3 | MH-213 | Communication Skills | T | | | | | √ | | | | √ | | | | |
| | MT-213L | CAD-II | L | | | | | √ | | | | | | | | |
| | MT-223 | Industrial Material | T | √ | | | | | | | | | | | | |
| | MT-223L | Industrial Material | L | | | | | √ | | | | √ | | | | |
| | MT-273 | Engineering Statics | T | √ | √ | | | | | | | | | | | |
| | MT-273L | Engineering Statics | L | √ | | | | | | | | | | | | |
| | MT-243 | Applied Thermodynamics-II | T | √ | | | | | | | | | | | | |
| | MT-243L | Applied Thermodynamics-II | L | | | | √ | | | | | | | | | |
| | MH-114 | Arabic for Understanding Quran | T | | | | | | | | | | | | | √ |
| 4 | MT-253 | Machine Design | T | √ | √ | | | | | | | | | | | |
| | MT-253L | Machine Design | L | | | | | √ | | | | | | | | |
| | MT-264 | Fluid Mechanics | T | √ | √ | | | | | | | | | | | |
| | MT-264L | Fluid Mechanics | L | | | | √ | | | | | √ | | | | |
| | MT-233 | Mechanics of Materials | T | √ | √ | | | | | | | | | | | |
| | MT-233L | Mechanics of Materials | L | | | | | √ | | | | √ | | | | |
| | MT-213 | Probability and Statistics | T | √ | | | | | | | | | | | | |
| | MM-212 | Total Quality Management | T | √ | √ | | | | | | | | | | | |
| | MH-223 | Technical Report Writing | T | √ | | | | | | | | | √ | | | |
| 5 | MT-313 | Heat Transfer | T | √ | | | | | | | | | | | | |
| | MT-313L | Heat Transfer | L | | | | √ | | | | | √ | | | | |
| | MT-324 | I C Engine | T | √ | | | | | | | | | | | | |
| | MT-324L | I C Engine | L | | | | √ | | | | | | | | | |
| | MT-333 | Dynamics | T | √ | √ | | | | | | | | | | | |
| | MT-333L | Dynamics | L | | | √ | √ | | | | | | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MT-343 | Manufacturing Process | T | √ | √ | | | | | | | | | | | |
| | MT-343L | Manufacturing Process | L | | | | | √ | | | | | | | | |
| | MM-313 | Project Management | T | | | | | | | | | | | | √ | |
| | MH-312 | Economics | T | √ | | | | | | | | | | | | |
| 6 | MT-353 | Instrumentation and Control | T | | √ | √ | | | | | | | | | | |
| | MT-353L | Instrumentation and Control | L | | | | √ | | | | | √ | | | | |
| | MT-363 | Mechanical Vibration | T | √ | √ | √ | | | | | | | | | | |
| | MT-363L | Mechanical Vibration | L | | | | √ | | | | | √ | | | | |
| | MT-384 | Refrigeration & Air Conditioning | T | √ | √ | | | | | √ | | | | | | |
| | MT-384L | Refrigeration & Air Conditioning | L | | | | √ | | | | | √ | | | | |
| | MT-384 | Material Handling and Safety | T | √ | | | | | | | | | | | | |
| | MT-384L | Material Handling and Safety | L | | | | √ | | | | | √ | | | | |
| | MT-393 | Project | L | √ | √ | √ | √ | √ | √ | | | | | | | |
| | MT-3103 | Project (Continue) | L | | | | | | | √ | √ | √ | √ | √ | √ | |
| 7 | MT-4116 | 16 week supervised Industrial/Field training | L | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | |
| 8 | MT-4216 | 16 week supervised Industrial/Field training | L | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | |

# 11. Scheme of Studies

## 11.1 First Year

**1st Semester:**

| S No | Course Code | Subject | Nature | Credit Hours | | Weekly Contact Hours | |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Theory | Practical |
| 1 | MH-112 | Islamic Studies/ Professional Ethics | Humanities | 1 | 0 | 1 | 0 |
| 2 | MS-113 | Applied Physics | Natural Science | 2 | 1 | 2 | 3 |
| 3 | MS-123 | Applied Mathematics-I | Natural Science | 3 | 0 | 3 | 0 |
| 4 | MS-133 | Applied Chemistry | Natural Science | 2 | 1 | 2 | 3 |
| 5 | MS-143 | Introduction to Computer Fundamentals | Computer Science | 1 | 2 | 1 | 6 |
| 6 | MT-113 | Workshop Technology | Engineering Foundation | 0 | 2 | 0 | 6 |
| **Total** | | | | 09 | 06 | **09** | **18** |
| **Grand Total** | | | | **09+06=15** | | **09+18 = 27** | |

**2nd Semester First Year:**

| S No | Course Code | Subject | Nature | Credit Hours | | Weekly Contact Hours | |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Theory | Practical |
| 1 | MS-153 | Applied Mathematic - II | Natural Science | 3 | 0 | 3 | 0 |
| 2 | MH-122 | Pakistan Studies | Humanities | 2 | 0 | 2 | 0 |
| 3 | MT-124 | Technical Drawing and CAD-1 | Engineering Foundation | 2 | 2 | 2 | 6 |
| 4 | MT-134 | Applied Thermo-dynamics- 1 | Engineering Foundation | 2 | 2 | 2 | 6 |
| 5 | MT-144 | Basic Electrical & Electronics | Engineering Foundation | 2 | 2 | 2 | 6 |
| **Total** | | | | **11** | **06** | **11** | **18** |
| **Grand Total** | | | | **11+06=17** | | **11+18=29** | |

## 11.2 Second Year

### 3rd Semester:

| S No | Course Code | Subject | Nature | Credit Hours | | Weekly Contact Hours | |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Theory | Practical |
| 1 | MH-213 | Communication Skills | Humanities/ English | 3 | 0 | 3 | 0 |
| 2 | MT-213 | CAD – II | Major based Breadth | 0 | 3 | 0 | 9 |
| 3 | MT-223 | Industrial Material | Engineering Foundation | 2 | 1 | 2 | 3 |
| 4 | MT-273 | Engineering Statics | Engineering Foundation | 2 | 1 | 2 | 3 |
| 5 | MT-243 | Applied Thermo-dynamics – II | Major based Breadth | 2 | 1 | 2 | 3 |
| 6 | MH-114 | Arabic for Understanding Quran | Humanities | 2 | 0 | 2 | 0 |
| **Total** | | | | 11 | 06 | 11 | 18 |
| **Grand Total** | | | | **11+06=17** | | **11+18=29** | |

### 4th Semester Second Year:

| S No | Course Code | Subject | Nature | Credit Hours | | Weekly Contact Hours | |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Theory | Practical |
| 1 | MT-253 | Machine Design | Major based Breadth | 3 | 0 | 3 | 0 |
| 2 | MT-264 | Fluid Mechanics | Major based Breadth | 2 | 2 | 2 | 6 |
| 3 | MT-233 | Mechanics of Material | Major based Breadth | 2 | 1 | 2 | 3 |
| 4 | MT-213 | Probability and Statistics | Natural Science | 3 | 0 | 3 | 0 |
| 5 | MM-212 | Total Quality Management | Management Sciences | 2 | 0 | 2 | 0 |
| 6 | MH-223 | Technical Report Writing | Humanities/ English | 3 | 0 | 3 | 0 |
| **Total** | | | | 15 | 03 | 15 | 9 |
| **Grand Total** | | | | **15+03=18** | | **15+9=24** | |

## 11.3 Third Year

**5th Semester:**

| S No | Course Code | Subject | Nature | Credit Hours | | Weekly Contact Hours | |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Theory | Practical |
| 1 | MT-313 | Heat Transfer | Major based Depth | 2 | 1 | 2 | 3 |
| 2 | MT-324 | I C Engine | Major based Depth | 2 | 2 | 2 | 6 |
| 3 | MT-333 | Dynamics | Major based Depth | 2 | 1 | 2 | 3 |
| 4 | MT-343 | Manufacturing Processes | Major based Depth | 2 | 1 | 2 | 3 |
| 5 | MM-313 | Project Management | Management Science | 3 | 0 | 3 | 0 |
| 6 | MH-312 | Economics | Humanities | 2 | 0 | 2 | 0 |
| **Total** | | | | **13** | **05** | **13** | **15** |
| **Grand Total** | | | | **13+05=18** | | **13+ 15 = 28** | |

**6th Semester:**

| S No | Course Code | Subject | Nature | Credit Hours | | Weekly Contact Hours | |
|---|---|---|---|---|---|---|---|
| | | | | Theory | Practical | Theory | Practical |
| 1 | MT-353 | Instrumentation and Control | Major based Depth | 2 | 1 | 2 | 3 |
| 2 | MT-363 | Mechanical Vibration | Major based Depth | 2 | 1 | 2 | 3 |
| 3 | MT-373 | Refrigeration & Air Conditioning | Major based Depth | 2 | 1 | 2 | 3 |
| 4 | MT-384 | Material Handling and Safety | Major based Depth | 3 | 1 | 3 | 3 |
| 5 | MT-393 | Project | Major based Depth | 0 | 3 | 0 | 9 |
| **Total** | | | | 09 | 07 | 09 | 21 |
| **Grand Total** | | | | **09+07=16** | | **09+21=30** | |

## 11.4 Summer Project Work (Third Year)

**6th Semester:**

| S. No | Course Code | Subject | Credit Hours | | Contact Hours | |
|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical |
| 1 | MT-3103 | Project (Continue) | 0 | 03 | 0 | 09 |
| **Grand Total** | | | **00+ 03 = 03** | | **00+09=09** | |

## 11.5 Fourth Year

### 7th Semester:

| S. No | Course Code | Subject | Credit Hours | | Contact Hours | |
|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical |
| 1 | MT-4116 | 16 Weeks Supervised Industrial / Field Training (8x5=40 Hrs / Week) | 0 | 16 | 0 | 40x16 = 640 |
| **Total** | | | **0** | **16** | **0** | **640** |
| **Grand Total** | | | **0+16=16** | | **0+640=640** | |

### 8th Semester:

| S. No | Course Code | Subject | Credit Hours | | Contact Hours | |
|---|---|---|---|---|---|---|
| | | | Theory | Practical | Theory | Practical |
| 1 | MT-4216 | 16 Weeks Supervised Industrial / Field Training (8x5=40 Hrs / Week) | 0 | 16 | 0 | 40x16 = 640 |
| **Total** | | | **0** | **16** | **0** | **640** |
| **Grand Total** | | | **0+16=16** | | **0+ 640 = 640** | |

# 12. Details of Courses

## 12.1 Semester 1

### ISLAMIC STUDIES MH-112 (1, 0)

**Objectives:**

This course is aimed at:
1. To provide Basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve Students skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Remember** the basic information about Islam. | C-1 | 12 |
| 2 | **Understand** Islamic worships, faith, and civilization to enhance a sense of religious practices. | C-2 | 12 |
| 3 | **Apply** principles of Quran, Sunnah, and Islamic Civilization in modern ways of life. | C-3 | 8 |

**Course Outline:**

Introduction to Quranic Studies
1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran
Study of Selected Text of Holy 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
5) 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 Jrisprudence 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)
9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)

## PROFESSIONAL ETHICS MH-112 (1, 0)

**Objectives:**

The objective of the course is to familiarize the students to:
1. Identify the nature of Professional Ethics in terms of Legal, Historical and Personal definitions
2. Understanding the value of professional ethics
3. Resolving the ethical dilemmas using common ethical values and identifying possible actions to be taken in response
4. Assessing the probable consequences

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Remember** basic concepts of professional ethics. | C-1 | 8 |
| 2 | **Understand** Islamic ethics, business ethics and codes of ethics for engineers. | C-2 | 8 |
| 3 | **Understand** attributes of morally courageous leadership. | C-2 | 8 |

**Course Outline:**

Introduction:

1. Definitions/Importance/Kinds
2. Factors/Sources of Islamic Ethics
3. Islamic Ethical System

Ethics in Business:

1. Enforcement of Ethical environment/factors
2. Principles & Decision Making
3. Islamic rules for business

4. Lawful and unlawful behavior in Islam
5. Engineering Ethics:
6. Scope & Aims, Theories, responsibilities
7. IEEE code of Ethics
8. Ethical code for Engineers
9. Ethical code for software Engineers

Moral Courage

1. Moral courage, its importance and how to improve?
2. Attributes of morally courageous leaders

Relevant Case Studies:

To be decided by the Teacher/Instructor

**APPLIED PHYSICS MS-113 (2, 1)**

**Objectives:**

The main objective of the course is to provide basic information about Electricity, Magnetism, Electromagnetism, waves and oscillations, optics, Electronics and Mechanics to the students.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Remember** the basic information relevant to sub-fields of Physics and its sub-fields. | C-1 | 1 |
| 2 | **Understand** fundamental laws of Physics. | C-2 | 1 |
| 3 | **Apply** knowledge of basic physical laws to solve problems from areas of Mechanical Technology like mechanics and vibrations. | C-3 | 1 |

**Course Outline:**

Waves & Oscillations : Periodic motion & Simple Harmonic Oscillation (SHO), Simple Pendulum, Transverse & Longitudinal Waves, Speed of a traveling Wave, Damped Harmonic Oscillator, EM waves.

Electricity: Basic terms & definitions; Electric Forces and Fields, Electric Flux, Coulomb's Law, Electric field due to the Point and Various Charges, Gauss's Law and its Applications, , Conductors in Electric Fields, Parallel Metal Plates ,Capacitance , Resistance, Electric Potential and Potential Energy, Ohms' Law, practice problems

Magnetism: Magnetic Field, Flux and Flux density (B), B-H loop, Hysteresis, Retentively, Magnetic Force on moving charges, Torque on Current Loop, Ampere's Law, Magnetic Dipole Moment. Earth's Magnetic Field, practice problems,

Electromagnetic Induction: Induced Current and EMF, Faraday's Law of Electromagnetic induction, Lenz's Law, Mutual and self-Inductance, Motional EMF, Inductor and Inductance, RL circuits
Electronics: Semiconductor materials, conduction in conductors, insulator and semiconductors, doping, N-type and P-type semiconductors, energy band diagrams of conductors, insulators, intrinsic and extrinsic Semiconductors, PN junction, basic diode operation, forward and reverse operating modes, Diode applications.
Light and Optics. Oscillating Electric and Magnetic Fields, Light as EM Wave, Reflection, Refraction, Interference, Young's Double Slit Experiment, Equivalent Optical Path, Diffraction,
Mechanics: Definitions of Work, Energy & Power, Work – Energy Theorem and its applications, Mechanical Energy of System, Conservation of Mechanical Energy, practice problems, Gravitational potential energy, Hook's Law & Restoring force. Review of Angular Variables, K.E. Energy of Rotation and moment of Inertia, Torque and Newton's Second Law of Rotation, Work and Rotational K.E., Angular momentum, Angular Momentum for System of Particles.

**APPLIED PHYSICS Lab**

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Practice** record keeping of experimental data and compare results to relevant theory. | **P-3** | **4** |
| **2** | **Contribute** to lab activities individually as well as in group | **A-2** | **9** |

**Lab Outline:**

1. Measuring magnitude and direction of Earth's a) magnetic field. b) To measure Dip angle.
2. Examining Lenz's and Faraday's Law. Studying the production of EMF using fix coil or fix magnet
3. Measurement of Current, Voltage drop and Power in a Resistance circuit
4. Diode; identification of Diode terminals using Ohm meter series circuits, Diode series circuit, Diode Parallel circuits
5. Half Wave rectification and Full Wave rectification
6. Measurement of wavelength of sodium light using diffraction Grating and Spectrometer
7. Study of diffraction minima and maxima using single and multi-slits.
8. Verification of Law of Conservation of Energy by measuring potential and kinetic energies in various arrangements a) Determine relationship between force and spring deformation using Hook's law. b) Investigating both spring compression and extension.

**Recommended Books:**

1. Halliday, Resnick and Walker, "Fundamental of Physics" (Latest Ed.)
2. Electrical Technology, Edward Hughes ,Longman Latest edition,

3. Principles of Electrical Engg.,B.R Gupta ,S. Chand and Company Ltd. India

**APPLIED MATHEMATICS – I MS-123 (3, 0)**

**Objectives:**

Introduction to derivation and integration

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** the basic concepts of Mathematics related to complex number, differentiation and integration. | **C-2** | **1** |
| **2** | **Solve** given problems using basic concepts of Mathematics related to complex number, differentiation, integration, cartesian coordinates and polar coordinates. | **C-2** | **1** |
| **3** | **Apply** basic concepts differentiation and integration in terms of graphical representation. | **C-3** | **1** |

**Course Outline:**

Complex numbers, Argand diagram, De Moivre‟s theorem, hyperbolic and inverse hyperbolic functions. Algebra of vectors and matrices, systems of linear equations. Derivative as slope, as rate of change (graphical representation). Extreme values, tangents and normals, curvature and radius of curvature. Differentiation as approximation. Partial derivatives and their application to extreme values and approximation. Integration by substitution and by parts, integration and definite integration as area under curve (graphical representation). Reduction formulae. Double integration and its applications. Polar and Cartesian coordinates, polar curves, radius of curvature, cycloid, hypocycloid, epicycloids and involutes of a circle.

**Recommended Books:**

1. Calculus and analytical Geometry, 11th Edition *By Thomas Finney* John Wiley & Sons.
2. Advanced Engineering Mathematics 5th Edition *By C. R. Wylie* McGraw-Hill Education.
3. Advanced Engineering Mathematics, 8th Edition *By* HT*Erwin Kreyszig* TH John Wiley & Sons.

**APPLIED CHEMISTRY MS-133 (2, 1)**

**Objective:**

The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials and analytical techniques.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Remember** the basic information relevant to Applied Chemistry and its sub-fields. | **C-1** | **1** |
| **2** | **Demonstrate** working knowledge of applied chemistry related to Thermodynamics, Electrochemistry and Engineering Materials. | **C-2** | **1** |
| **3** | **Understand** concepts and terminologies related to water impurities, water treatment and implications of water usage in applications like boilers. | **C-2** | **1** |

**Course outlines:**

Chemical kinematics and catalysis: Introduction to rate equation and reaction order, reaction mechanism, relation between rate equation and reaction mechanism, First order & Second order. Dependence of temperature on reaction rates. Arrhenius theory, collision theory, Transition – state theory, Physical adsorption, chemisorption, Freundlich's expression, Langmuir adsorption isotherm, Heterogeneous catalysis, examples of heterogeneously catalysed reactions.
Features of Coordination Chemistry & Organic Reaction Mechanism: Coordination chemistry, coordination number, chelate effect, coordination complexes and their applications. Electrophilic substitution reactions in aromatic systems. Some Name reactions viz. Hoffman's rearrangement, Beckman's reaction, Riemer-Tiemann reaction, Skraup synthesis, etc.
Thermodynamics and electrochemical Phenomenon: Heat, work and energy, reversible and irreversible processes, work done in an isothermal reversible expansion of ideal gas. Enthalpy. Entropy. Electrochemical and galvanic series, polarization, decomposition potential, over voltage. Theories of corrosion. Differential aeration theory. Factors influencing corrosion. Types of corrosion Control of corrosion: Design and material selection, anodic and cathodic protection, protective coatings, corrosion inhibitors. Fuel Cells.
Analytical aspects of water: Sources, conservation of water, impurities in water and their effects. WHO guideline and BIS guideline for drinking water. Chemistry involved in sedimentation, coagulation and sterilization. Softening of water, lime-soda, ion-exchange process and numerical problem. Boiler troubles, causes and effects, methods of prevention.
Engineering Materials: Glass, ceramics, refractory, composites, magnetic materials, Polymers & structure property relationship. Thermoplastic & thermosetting plastics. Preparation, properties & applications of some commodity and engineering polymers. Conducting polymers.

Interaction of radiation with matter: Molecular spectroscopy, vibrational, rotational, absorption, emission and light scattering phenomenon.

**Recommended Books:**

1. Dara, S.S.; A Text Book of Engineering Chemistry (Tenth edition); S. Chand, 2003.
2. Kuriacose, J.C., Rajaram, J.; Chemistry in Engineering and Technology (Vol. 1&2); McGraw Hill, 1984.
3. Barrow, M. Gordon; Physical Chemistry (Fifth edition); McGraw-Hill, 1992.
4. March, Jerry.; Advance Organic Chemistry Reaction Mechanism and Structure (Fourth edition); John Wiley & Sons New York, 2004.
5. W. Kemp; Organic spectroscopy ( III Edition ) PALGRAVE, 2002.
6. Puri B.R., Sharma L.R., Pathania M.S; Principles of Physical Chemistry; Vishal Publishing Co. (42nd Edition).

**APPLIED CHEMISTRY MS-133L (1)**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | | | |
| **2** | | | |

**INTRODUCTION TO COMPUTER FUNDAMENTALS MS-143 (1, 2)**

**Objectives:**

To assemble or disassemble computers and plug-in devices. Enable students to design an optimal computer system environment as per need of customer. Pros and cons of computer business and applications.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Remember** the basic information relevant to computers. | **C-1** | **1** |
| **2** | **Demonstrate** working knowledge of different components of computer hardware and software. | **C-2** | **1** |
| **3** | **Understand** various means of communication and interaction through computers and internet and their social implications. | **C-2** | **6** |

**Course Outline:**

Basic terminology: computer, user, hardware, software, chip, program, Input: data, instructions (programs, commands, user responses), Output: text, graphics, video, audio, Types of computers:

personal, notebook, handheld, PDA, internet appliance, server, mainframe, supercomputer, Programming languages, Machine, assembly, High-level, Key terms: VLSI, microprocessor, microcomputer, Computer Software: Terms: file, menu, font, voice recognition, FAQ, online help, wizard, software suite, single-user license, site license, application window, dialog box, clip art, cross-platform application, Application software, Word processing, Spreadsheet: cell, function, recalculation, charting, Database: record, field, query, Other: accounting software, Computer Aided Design (CAD), desktop publishing, paint/image, multimedia, web authoring, System software, Operating System (OS), Booting (startup), Cold vs. warm, BIOS, Steps in booting, Utility programs: file viewer, file compression, backup, screen saver, disk scanner, disk defragmenter, Computer hardware, System unit Terms: motherboard, chip, memory, storage, expansion slot (plug and play), port (serial vs parallel), bus (expansion bus), power supply, Central Processing Unit (CPU), Machine cycle (fetch, decode, execute, store), Memory, Volatile vs. nonvolatile, RAM vs ROM, Cache, Hard disk, Tracks, sectors, platters, RAID (mirroring and striping), Internet hard drive, Compact disks (and drives), PC Cards, Miniature mobile storage (Compact Flash, Memory Stick, Microdrive, Smart Media), Input Devices: Keyboard, Pointing Devices, Others: trackball, touchpad, pointing stick, light pen, touch screen, stylus, Handwriting recognition software, Sound, Image: Digital camera, Scanners (flatbed, optical readers), Optical readers, Optical character recognition (OCR), bar code scanner, Optical Mark Recognition (OMR), Video: Web cam, PC Video camera, Output Devices, Display device, CRT monitor, Liquid Crystal Display (LCD) – passive versus active matrix, Gas plasma monitor, Printer and its types: Impact printers, Dot-matrix printer, Line printer, Plotter, Non-impact printers, Ink-jet, Laser, data projector, fax machine (fax modem), Internet, E-commerce, Ethics and social issues, Privacy and security.

**Lab CLO's**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Describe** fundamental concepts of computing. | P-1 | 5 |
| 2 | **Practice** Microsoft visio & Microsoft office tools i.e MS Word, MS PowerPoint, MS Excel. | P-3 | 5 |

**Lab Outline:**

1. Basic machines organization including motherboard, memory, I/O cards, networking devices
2. Use of flow charts
3. Computer peripheral devices
4. Operating Systems
5. Microsoft Windows
6. Microsoft Office i.e. MS Word, MS PowerPoint, MS Excel
7. Office Tools & Overview of different browsers with emphasis on power point
8. Microsoft Visio

**Recommended Books:**

1. Peter Norton, "Introduction to Computers", Latest Edition
2. Misty E. Vermaat, "Discovering Computers", Shelly Cashman Series, Latest edition.

**WORKSHOP TECHNOLOGY MT-113 (0, 2)**

**Objectives:**

After the completion of the course, the student shall be able to Practice workshop safety rules effectively Acquire knowledge and use simple hand tools Acquire knowledge and use simple measuring and gauging instruments Operate simple drilling machines for producing small holes Operate various machine tools for producing simple metal components and articles Acquire knowledge and practice on foundry, forging and welding

**CLOS**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Describe** different machines, equipment and processes related to various mechanical workshops. | **C-2** | **1** |
| **2** | **Operate** to show development of parts by utilizing machines from different shops. | **P-5** | **3** |
| **3** | **Practice** the correct and safe usage of machine and its components, tools. | **A-2** | **5** |

**Course outlines:**

**Work Shop**

1. Workshop Safety precaution for each workshops.
2. Introduction to Machining theory & practice.
3. Mechanism of Chip Formation & Types.
4. Tool Life, Cutting force, Cutting Tool Materials, Cutting Fluids & Machine able Material.
5. Lathe & Milling Types Construction & Operation's.
6. Parameters, Calculations of MMR, Power and Cutting Time.
7. Accessories Index Milling, Gear Manufacturing through milling.
8. Planning, Shaping, Broaching & Gear Hobbing Operations.
9. Principle, Tools, Applications.
10. Machining of Alloys, Super Alloy & high Grade Material.
11. Precision Machining.
12. Electric Discharge Machine (EDM) (Wire Cut, Die Sinking Machine)
13. Capabilities, Capacities, programming & Tools.
14. NC CNC & DNC Machines, Coordinate Measuring Machine (CMM).
15. Capabilities, Capacities, programming & Tools.
16. High Speed Machining, Mass Production through Machining.
17. Special Machining Techniques, (chemical Machining, Laser Machining)

18. Finishing Operations.
19. Grinding, Honing, Lapping, Polishing and Buffing
20. Welding Techniques Welding Theory & types.

Arc welding Tig & Mig Welding, Gas Welding, Spot Welding soldering & brazing. Fusion welding process: Oxy-fuel gas welding, thermit welding, electron beam welding, Pressure Welding Resistance Welding, Solid State welding process: Cold welding, ultrasonic welding, friction, filler, flux & electrode for welding & different Process. Weld quality weld ability, weld design & metals, process selection, adhesive bonding, joining plastics

**12.2 Semester 2**

**APPLIED MATHEMATICS – II MS-153 (3, 0)**

**Objectives:**

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** types of differential equations and their solution techniques. | **C-2** | **1** |
| **2** | **Solve** given problems related to differential equations, D-operators, complementary functions, particular integrals and Laplace transformation. | **C-3** | **1** |
| **3** | **Understand** concepts related to Cauchy equation, non-homogenous linear equations, and high order linear differential equations | **C-3** | **1** |

**Course Outline:**

Differential equation; basic concepts and ideas; geometrical interpretation of first and second order differential equations; separable equations, equations reducible to separable form, exact differential equations, integrated factors. Linear first order differential equations, Bernoulli‟s differential equation.
Families of curves, orthogonal trajectories and applications of differential equations of first order to relevant engineering systems. Homogeneous linear differential equations of second order, homogeneous equations with constant coefficients, the general solutions, initial and boundary value problems, D-operator, complementary functions and particular integrals. Real, complex and repeated roots of characteristics equations. Cauchy equation, non-homogeneous linear equations. Applications of higher order linear differential equations. Ordinary and regular points and corresponding series solutions; introduction to Laplace transformation

**Recommended Books:**

1. Advanced Engineering Mathematics 5th Edition *By C.R. Wylie* McGraw-Hill Education
2. Advanced Engineering Mathematics,8th Edition *By* HT*Erwin Kreyszig*TH John Wiley & Sons.

**PAKISTAN STUDIES MH-112 (2, 0)**

**Objectives:**

1. Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
2. Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** geo-physical, societal and cultural factors that led to Muslim Separation Movement. | **C-2** | **6** |
| **2** | **Understand** political, legal and constitutional phases of Pakistan. | **C-2** | **6** |
| **3** | **Assess** economic, foreign policy and ethnic challenges/issues being faced by Pakistan. | **C-5** | **6** |

**Course Outline:**

1. Historical Perspective
2. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
3. Factors leading to Muslim separatism
4. People and Land
5. Indus Civilization
6. Muslim advent
7. Location and geo-physical features.

2. Government and Politics in Pakistan
Political and constitutional phases:

1. 1947-58
2. 1958-71
3. 1971-77
4. 1977-88
5. 1988-99
6. 1999 onward

3. Contemporary Pakistan

1. Economic institutions and issues
2. Society and social structure
3. Ethnicity
4. Foreign policy of Pakistan and challenges
5. Futuristic outlook of Pakistan

**Recommended Books:**

1. Burki, Shahid Javed. *State & Society in Pakistan,* The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy.* Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. Pakistan‟s Foreign policy: An
Historical analysis. Karachi: Oxford University Press, 1993.

4. Mehmood, Safdar. *Pakistan Political Roots & Development.* Lahore, 1994.
5. Wilcox, Wayne.*The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota,* Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.

**TECHNICAL DRAWING AND CAD-1 MT-124 (2, 2)**

**Objectives:**

The objective of the course is to familiarize the students with drawing of geometrical shapes and drawing standards.

**CLOS**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamentals of engineering drawing and graphics. | C-2 | 1 |
| 2 | **Understand** principles of Fits and Tolerances, and Sections and Sectional Views of Engineering Drawing. | C-2 | 1 |
| 3 | **Draw** in accordance with principles of Orthographic Projections and Isometric Projections. | C-4 | 1 |

**Course outline:**

**1. Introduction to Engineering Drawing:** covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular, Hyperbola , Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;
**2. Technical Drawing Standards** General principles of presentation, conventional representation of dimensioning and sectioning, threaded parts, gears, springs and common features. Abbreviations and symbols used in technical drawings. Symbols and method of indication on the drawing for surface finish, welding and riveted joints.
**3.Orthographic Projections covering**, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes, inclined Planes - Auxiliary Planes;
**4. Projections of Regular Solids covering**, those inclined to both the Planes- Auxiliary Views;
**5.Sections and Sectional Views of Right Angular Solids covering**, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone;
**6.Isometric Projections covering**, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions
**7. Fits And Tolerances** Tolerance types and representation on the drawing – Fits types and selection for different applications – Basic hole systems - Basic shaft systems – Allowances. Geometric tolerances – Form and positional. Datum and datum

**TECHNICAL DRAWING AND CAD-1 LAB MT-124L**

**OBJECTIVE:**

This course is a part of engineering foundation. It is targeted to help student visualize the basics of engineering design. It is intended for improving students approach towards conceptual design.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Sketch** 2-D Drawings using orthographic projections. | **P-4** | **1** |
| **2** | Show **grasp** over existing CAD software for designing mechanical components | **P-4** | **5** |
| **3** | **Demonstrate** positive working attributes by working individually and working with a group. | **A-3** | **9** |

**Lab Outline:**

1.Setting up of drawing environment by setting drawing limits, drawing units, naming the drawing, naming layers, setting line types for different layers using various type of lines in engineering drawing, saving the file with .dwg extension.
2. Draw different types of bolts and nuts with internal and external threading in Acme and square threading standards. Save the bolts and nuts as blocks suitable for insertion.
3. Draw 3D models by extruding simple 2D objects, dimension and name the objects.
4. Draw a spiral by extruding a circle.
5. Construction of inscribes and circumscribes square, triangle and hexagon.
6. Construction of tangent of circle inside and outside
7. Construction of hyperbola curve
8. Construction of involutes and cycloids
9. Orthographic projection 1 and 3rd angle of any Given Block
10. Isometric and orthographic views of hexagonal nut and bolt.
11. Drawing of welding symbols.
12. Draw sectioning symbols for different materials
13. Development of Prism, Cylinder, Cone and Pyramid
14. Development of the truncated Prism, Cylinder, Cone and Pyramid

**Recommended Books:**

1. Engineering Drawing. by French & Vierck. (Latest Edition)
2. Geometrical Drawing by N.D. Bhatt. (Latest Edition)

**APPLIED THERMO DYNAMICS - 1 MT-134 (2, 2)**

**Objectives:**

The objective of the course is to familiarize the students with Laws of thermo, thermo cycles, and working of different thermal equipment.

**CLOS**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** concepts related to Thermodynamic system, Laws of Thermodynamics. | C-2 | 1 |
| 2 | **Solve** problems using laws of thermodynamics. | C-3 | 1 |
| 3 | **Apply** laws of Thermodynamics to open and closed systems. | C-3 | 1 |

**Course outline:**

Thermodynamic systems; States, processes, heat and work; Zeroth law; First law; Properties of pure substances and steam, Mollier diagram; Second law, Carnot cycle, entropy, corollaries of the second law; Application of first and second laws to closed and open systems; irreversibility and availability, energy analysis; Thermodynamic relations; Properties of mixtures of ideal gases; Thermodynamic cycles - Otto, Diesel, dual and Joule, Third Law of Thermodynamics.

**APPLIED THERMO DYNAMICS - 1 LAB MT-134L**

**OBJECTIVE:**

To able students to demonstrate the application of the First Law, Second Law, conservation of mass and properties of substances to practical engineering systems.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | Operate & **Manipulate** thermometers, Marcet Boiler, Mini Steam Turbines, and Compressors to determine various thermodynamics properties | P-4 | 4 |
| 2 | **Grasp** the knowledge of the four and two stroke engines to Observe different thermodynamics processes. | P-4 | 4 |
| 3 | **Demonstrate** positive working attributes by working individually and working with a group. | A-3 | 9 |

**Lab. Outline:**

1.To measure a regular and irregular shaped area with the help of Planimeter / Mechanical Integrator To measure area of indicated PV diagram; with the help of Planimeter / Mechanical Integrator.
2.To analyze the thermodynamic systems and its properties
3.Study of working principle of external combustion engine.
4.Study of working principle of internal combustion engine.
5.To study and analyze the erecting, installation, maintenance and working principles of water tube and fire tube boilers.

**Recommended Books**

1. R E Sonntag, C Borgnakke and G J Van Wylen, Fundamentals of Thermodynamics, 6th Ed., John Wiley, 2003.
2. G F C Rogers and Y R Mayhew, Engineering Thermodynamics Work and Heat Transfer , 4th Ed., Pearson 2003.

**References:**

1. J P Howell and P O Buckius, Fundamentals of Engineering Thermodynamics, McGraw-Hill, 1992.
2. Y. A. Cengel and M. A. Boles, Thermodynamics, An Engineering Approach, 4th Ed., Tata McGraw-Hill, 2003

**BASIC ELECTRICAL & ELECTRONICS MT-144 (2, 2)**

**Objectives:**

The objective of the course is to familiarize the students with principles of A.C machines, D.C machines, Transformers and its working.

**CLOS**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** basic concepts and laws of Electrical & Electronics. | C-2 | 1 |
| 2 | **Solve** problems using laws of Electrical & Electronics. | C-3 | 1 |
| 3 | **Understand** construction and working of electrical transformers, AC & DC machines, electrical transistors and electrical diodes. | C-2 | 1 |

**Course outline:**

Basic concepts of voltage, current, resistance, capacitance, inductance, series circuits, parallel circuits, series parallel combination, calculations, Ohm law, law of resistance.
Construction and Working principles of DC Machines and their types, speed control of DC motors, working principles and applications of AC machines.
Construction and working principles of single and three phase transformers. Insulators, semiconductors, type of semiconductors, doping, PN-junction diode, Rectifier and their types, construction and working principles of Bipolar junction transistors, Construction and working principles of BJT amplifiers.

**BASIC ELECTRICAL & ELECTRONICS LAB MT-144L**

**OBJECTIVE:**

The objective of this lab is to verify the working principles, and to implement the basic concepts of different electronics components in practical form including transistors, diodes, Gates and rectifiers. How to use basic level concepts of electronic devices in practical life.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Practice** experiments to investigate & note basic electrical quantities, implementation of KVL & working of motors and transformers. | **P-3** | **4** |
| **2** | Perform **& Repeat** experiment to investigate and note the behavior of different electronic components such as logic gates, diode, transistor, LDR, temperature sensors etc. | **P-3** | **4** |
| **3** | **Demonstrate** positive working attributes by working individually and working with a group. | **A-3** | **9** |

**Lab Outline:**

1. Using ohm meter to find the resistance of an unknown Resistor.
2. By using volt meter the voltage across a resistive load.
3. Using Am-Meter fin the current flowing in a circuit.
4. Verify Ohm's Law in a D.C circuit.
5. Resistor color coding
6. Find the Equivalent resistance of a series, parallel and series-parallel combination of Resistors.
7. To control the speed of D.C motor by using various techniques.
8. Study the basic module of a single phase motor
9. Study the Basic Module of A.C motor.
10. Find the turn ratio of a single phase transformer

11. Biasing modes of PN-junction diode.
12. Construct Half wave and full wave rectifier.
13. Biasing mode of BJT
14. Construction various types of amplifier using BJT.
15. To measure Gain and efficiency of an amplifier.

**Recommended Books:**

1. B.L. Theraja A text book of Electrical Technology Vol-2(Latest Edition)
2. Edward Huges- Electrical Technology (Latest Edition)
3. Electronics devices By Floyd (Latest Edition)

**12.3 Semester 3**

**COMMUNICATION SKILLS MH-213 (3, 0)**

**Objectives:**

1. To understand the importance and basic concepts of communications.
2. Recognize the importance of communicating effectively in technical writing and presentation.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** communication through writing with clarity and consistency. | **C-2** | **10** |
| **2** | **Understand** process of document creation and communication during project management. | **C-3** | **10** |
| **3** | **Create** presentations using Power Point. | **C-6** | **5** |

**Outline:**

Characteristics of Writing at Work. Writing for your Readers, Understand and apply the purpose, problems, and processes of written technical communications in the Workplace, Writing Ethically, Achieving a Readable Style, Analyze and adapt to various technical writing situations, Designing Documents, Designing Illustrations, Understand and apply the key phases of project management communication, Create documents that are grammatically and stylistically correct and effectively anticipate the audience's, information needs, Use the concepts of technical writing to self-assess your documents and critically evaluate others' work, Meet deadlines similar to those found in technical workplaces, Create and present professional presentations, including PowerPoint slides.

**Recommended Books:**

1. Elizabeth Tebeaux and Sam Dragga- The Essentials of Technical Communication. 2nd Edition, Oxford University Press.
2. Ron White- Writing. Advanced. Oxford Press.
3. John Langan- College Writing Skills. 9th Edition Connect Writing

**CAD – II MT-213 (0, 3)**

**Objectives:**

The objective of the course is to familiarize the students with the solid part and assembly modeling.

**CLOS**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Sketch** different geometrical mechanical components with the help of CAD software. | P-4 | 5 |
| 2 | **Assemble** the mechanical components with the help of CAD software. | P-5 | 5 |
| 3 | **Display** sketches of the components and assembled parts with the help of CAD software | P-5 | 5 |

**COURSE OUTLINES:**

**UNIT 1: Introduction to 2D and 3D CAD**

Modules, Toolbars, Units and Dimensions, Important Terms and Definitions.

**UNIT : 2 D Sketch**

Sketch Environment, Drawing Display Tools, Sketching Entities Pattern, Tolerance, Work Feature.

**UNIT :Dimension and Constraint**

Dimension, Geometric Constraint, Perpendicular Constraint Parallel Constraint, Tangent Constraint, Coincident Constraint Concentric Constraint, Collinear Constraint, Horizontal Constraint Vertical Constraint, Equal Constraint, Fix Constraint Symmetric Constraint, Smooth Constraint, Measurement

**UNIT 4 : 3D Sketch**

Parameter, 3D Sketching Entities

**UNIT 5 : Solid Modeling**

5.1 Modeling Tools, 5.1.1 Extrude Feature,5.1.2 Revolve Feature
5.1.3 Holes Feature, 5.1.4 Fillets Feature, 5.1.5 Chamfers Feature
5.1.6 Ribs Feature, 5.1.7 Thicken and Offset Feature
5.2 Concept of Edit Feature, 5.3 Advanced Modeling Tools
5.3.1 Sweep Feature, 5.3.2 Lofted Feature, 5.3.3 Coil Feature
5.3.4 Thread Feature, 5.3.5 Shell Feature, 5.3.6
Face Draft Feature
5.3.7 Replacing Face Feature, 5.3.8 Boundary Patch Feature,
5.3.9 Stitching Surfaces Feature
5.3.10 Sculpt Feature

**UNIT 6 : Assembly Modeling**

6.1 Types of Assembly,
6.2 Assembly Component
6.2.1 Mate Constraint
6.2.2 Angle Constraint
6.2.3 Tangent Constraint,

6.2.4 Insert Constraint
6.2.5 Rotation Constraint
6.2.6 Rotation-Translation Constraint
6.2.7 Transitional Constraint
6.3 Edit Assembly Constraint
**UNIT 7: Drawing View**
7.1 Types of Views,7.2 Drawing Standards,7.3 Drawing Sheets
7.4 Dimension Style 7.5 Parts Lists
**UNIT 8: Presentation Module**
8.1 Presentation View
8.2 Assembly Animation
Recommended books:
1. The CNC Work Shop by Frank Nanfara (Publisher: SDC Publications, 2002)
CAD SOFTWARE
Pro-engineering, power shape, catia, solid works etc.

**INDUSTRIAL MATERIALS MT-223 (2, 1)**

**OBJECTIVE:**

To get familiar with basic operations of spot welding, oxyacetylene welding, foundry, power press, bending machine, roller machine and rivet gun.

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** atomic/molecular structure of different engineering materials like metals, alloys, polymers and composite. | **C-2** | **1** |
| **2** | **Understand** extraction, crystalline formation diagram and treatment of different metals. | **C-2** | **1** |
| **3** | **Understand** different types of naming & testing standards of engineering materials. | **C-2** | **1** |

**Course Outline:**

1. Crystal in Structure of Metals.
2. Unit Cells, Dendrite Formation, Grains Boundary and Grain Size, Slip
3. Planes Effect of Hot and Cold working. Formation of Alloys
4. Binary Alloys, Equilibrium Diagram, Cooling Curves, Solid Solution.
5. Eutectic Alloy, Intermetallic Compounds.
6. Introduction to single and poly-crystal materials.

7. Ferrous and Non- Ferrous Metals. Equilibrium Phase Diagrams and their industrial importance. The Fe-Fe3C Equilibrium diagram and Refining.
8. Extraction of Common Metals
9. Iron and steel, Aluminum, Copper, Magnesium, Lead and Zinc. Heat Treatment
10. Hardening, Tempering, Annealing, Case Hardening, Heat Treatment Equipment.
11. Materials for High Performance Applications.
12. Metal Matrix Composites, Titanium Alloys, Reinforce Plastics, Properties and Applications.
13. Ferrous Metals, Non-Ferrous Metals. Polymers and Composite Materials.
14. The Structure, Types, Additives, General Properties, Applications.
15. Materials damaging modes during applications, Fracture, Fatigue, Wear etc.
16. Material, Testing, Tension Test, Hardness Test, Torsion Test, Fracture Mechanics, Fatigue, Brittle and Impact Testing.
17. Testing of Materials, Standard codes; ASTM, BSI, etc.
18. Materials naming conventions as per AISI-SAE, ASTM, ISO/BS standards.

**INDUSTRIAL MATERIALS LAB MT-223L**

**OBJECTIVE:**

To get familiar with basic operations of spot welding, oxyacetylene welding, foundry, power press, bending machine, roller machine and rivet gun.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Perform** different test on materials and record results. | **P-2** | **5** |
| **2** | **Practice** under supervision various equipment's. | **P-3** | **5** |

**LAB OUTLINE:**

1. To prepare steel specimens using appropriate macro etching reagents and to reveal segregation and crystal structure.

2. To prepare steel specimens using appropriate macro etching reagent and to reveal variation in crystal structure.

3. To prepare steel specimens using appropriate macro etching reagents and to reveal deformation lines in steel.

4. To prepare specimens of aluminum using appropriate macro etching reagents and to reveals their crystal structures.

5. To prepare the specimens of brass, bronze and copper using appropriate macro etching reagents and to reveal their crystal structures.

6. To prepare the specimens of steel for micro examination and to conduct the micro examination using metallurgical microscope.

7. To prepare the specimens of cast iron for micro examination using metallurgical microscope.

8. To conduct the micro examinations of austenitic and stainless steel by preparing of their specimens using metallurgical microscope.
9. To conduct the micro examination of aluminum and aluminum alloy by preparing their specimens using metallurgical microscope.
10. To conduct the micro examination of copper and copper alloys by preparing their specimens using metallurgical microscope.
11. To conduct the micro examination of magnesium and magnesium alloys by preparing their specimens using metallurgical microscope.
12. To conduct the micro examination of PVC and bake lite by preparing their specimens using metallurgical microscope.
13. To determine the Brinell hardness number of the given specimens of ferrous, non-ferrous and non-metallic materials.
14. To determine the Rockwell hardness number of the given specimens of ferrous, non-ferrous and non-metallic materials.
15. To perform the induction hardening process on the given part.
16. To perform the flame hardening process on the given part.
17. To perform the tempering process on the given part.

**Recommended Text Book**

1. Kempster MHA. Materials fo engineers. English Language Book Society, UK.
2. HIGGINS R.A. engineering metallurgy: part 1, Applied Physical Metallurgy, Hodder and Stoughton, London.
**3.** Material Science and engineering an introduction (seventh edition) by William D. Callister, Jr.

**Reference Books:**

1. Neely JE. Practical metallurgy. Prentice Hall, USA
2. Avner mechanical metallurgy. McGraw-Hill Book Company, U.K
3. Essentials of material science and engineering by Donald R. Askeland.

**MECHANICS OF MATERIAL MT-233 (2, 1)**

**OBJECTIVE:**

To enable the students to understand the internal effect of forces on various mechanical and structural members

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** concepts of stress, strain, stress-strain diagram, Mohr's Circle, mechanical properties of materials, bending moment diagrams and torsion. | **C-2** | **1** |
| **2** | **Solve** given problems related to differential mechanical components. | **C-3** | **1** |
| **3** | **Analyze** beams, bars, shafts, and cylinders using principles of Mechanics of Materials. | **C-4** | **2** |

**COURSE OUTLINES:**

1. Mechanical properties of Materials
2. Elastic constants and their relationships
3. Tensile stress, Compressive stress, Shear stress
4. Strain (Longitudinal, Lateral and volumetric)
5. Compound bars
6. Thermal stress
7. Moment of inertia
8. Shear force and Bending moment of beams
9. Shear stress and deflection of beams
10. Torsion of circular bars, hollow and compound shafts
11. Strain energy
12. Thin and thick pressure vessels
13. Plain stress and strain principal stress and strain, Mohr's circle
14. Theories of failure
15. Virtual work and associated energy theorems
16. Photo elasticity and strain gauges

**MECHANICS OF MATERIAL LAB MT-233L**

**OBJECTIVE:**

To improve students' cognitive and psychomotor skills. To understand the basic principles of Mechanics of Materials and Laws of Mechanics. Mechanics of Materials Laboratory gives the student basic tools for stress, strain and deformation analysis, methods for determining the Stresses, strains and deformations produced by applied loads.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Perform** different experiments related to UTM and torsion testing machine. | **P2** | **5** |
| **2** | **Contribute** to lab activities individually as well as in group | **A2** | **9** |

**Lab Outlines:**

1. Study of Material testing lab
2. Study of Universal Testing Machine
3. Tensile test of mild steel specimen on UTM
4. Compression test on cement mortar cube
5. Shear test on mild steel specimen
6. Torsion test on mild steel, cast iron and brass

**Recommended Books:**

1. Mechanic of Materials by F.P. Beer and E.R. Johnston
2. Mechanics of Engg Materials by F.V. Warnock P.P. Benham and R.J Crawford
3. Strength of Materials by F. Singer

**APPLIED THERMODYNAMICS – II MT-243 (2, 1)**

**Objectives:**

The objective of the course is to familiarize the students with the construction and working of Engines, Turbines and compressors.

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** different standard air cycles. | **C-2** | **1** |
| **2** | **Solve** problems using Cycles and Laws of Thermodynamics. | **C-3** | **1** |
| **3** | **Apply** Thermodynamic Laws and thermodynamic cycles on IC Engines and Turbines. | **C-3** | **1** |

**Course Outlines:**

1. I C. Engines: Classification - SI, CI, two-stroke, four-stroke etc., operating characteristics – mean effective pressure, torque and power, efficiencies, specific fuel consumption etc.
2. Air standard cycles – Otto, Diesel and dual, real air-fuel engine cycles, Thermochemistry of fuels – S.I. and C.I. engine fuels, self-ignition, octane number, cetane number, alternate fuels etc. Combustion – combustion in S.I. and C.I. engines, pressure-crank angle diagram, air-fuel ratio, chemical equation and conservation of mass in a combustion process etc.
3. Air and fuel injection – injector and carburetor, MPFI etc., ignition, lubrication, heat transfer and cooling; Gas Power Cycles: Simple gas turbine cycle – single and twin shaft arrangements, intercooling, reheating, regeneration, closed cycles, optimal performance of various cycles, combined gas and steam cycles; Introduction to Axial-Flow Gas
4. Turbine; Introduction to Centrifugal and Axial Flow Compressors; Combustion Chambers; Jet Propulsion: turbojet, turboprop, turbofan, ramjet, thrust and propulsive efficiency; Rocket Propulsion; Direct Energy Conversion: thermionic and the of working permoelectric converters, photovoltaic generators, MHD generators, fuel cells.

**APPLIED THERMODYNAMICS – II LAB MT-243L**

**OBJECTIVE:**

To able students to demonstrate the application of the First Law, Second Law, conservation of mass and properties of substances to practical engineering systems.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Identify** different components of and their working in different types of engines. | **P-1** | **4** |
| **2** | **Explain** working principal of water tube and fire tube boilers. | **P-2** | **4** |

**Lab Outlines:**

1. Study of working principal of external combustion engine
2. Study of working principal of internal combustion engine
3. To measure indicated and brake horse power
4. Study of working principal of water tube and fire tube boilers

**Recommended Books:**

1. G. F. C. Rogers and Y. R. Mayhew, Engineering Thermodynamics Work and Heat Transfer, 4 th Ed., Pearson, 2001.

2. H. I. H Saravanamuttoo, G. F. C. Rogers and H. Cohen, Gas Turbine Theory, 4 th Ed., Pearson, 2003.

**References:**

1. T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, 5th Ed., Pearson, 1999.
2. W. W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, PHI, 2002.
3. C. R. Fergusan and A. T. Kirkpatrick, Internal Combustion Engines, John Wiley & Sons, 2001.

**ARABIC FOR UNDERSTANDING QURAN MH-114 (2,0)**

**CLO's**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Memorize** vocabulary and verses of Quran. | C-1 | 12 |
| 2 | **Translate** few verses of the Holy Quran in the light of principles of Arabic Grammar. | C-2 | 12 |

**Course Outlines:**

| | |
|---|---|
| The Alphabet (28+1) | **حروف هجَا / تهجّي** |
| 3 Long Vowels (Alif – waw – ya) | **حروف مَدّة** (الف – واو – ى) |
| 3 Short Vowels (u-a-i) | **الحركات:** (ضمة/ پيش/ رفع) – ( فتحة / زبر/ نصب) - (كسرة / زير / جرّ) |
| 2 Dipthongs (au/aw – ai/ay) | **واو - ى** |
| Jazma | **جزمة / سُكُون** |
| Shortend Alif | **الف مقصورة** |
| Ta marbuta (Round) | **تاء مربوطة** |
| Definite Article | **ال / حرف تعريف** |
| Nunation/Indefinite Article | **تنوين / حرف تنكير** |
| Sun / Solar Letters | **الحروف الشّمسية** |
| Moon /Lunar. Letters | **الحروف القمرية** |
| Tashdid/Shadda/Doubled letters | **تشديد/شدّة** |
| Hamza of Connection and Ordinary Hamza | **بمزة الوصل و بمزة القطع** |
| **Word: Parts of Speech:**<br>1. **Noun** (Nouns-Pronouns-Adjectives-Adverbs)<br>**2. Verb**<br>3. **Particle** (Prepositions, Conjunctions, Interjections & Vocative Particles) | **أنواع الكلمة:** (اسم – فعل – حرف)<br>**اسم :** (اسم - ضمير – صفت – ظرف)<br>**فعل :** (فعل)<br>**حرف:** حرف جرّ – حرف عطف – حرف نداء – فجائية) |
| **Definite Nouns:**<br>• Proper Noun,<br>• Personal Pronouns,<br>• Demonstrative Pronouns,<br>• Relative Pronouns,<br>• Noun having Definite Article,<br>• Vocative Nouns/Case,<br>• Related to a Definite Noun | **اسماء المعرفة:**<br>اسم عَلَم ،<br>اسم ضمير،<br>اسم اشارة ،<br>اسم موصول ،<br>اسم مُنَادى،<br>معرف باللام و<br>مضاف الى المعرفه |
| **Indefinite Nouns:**<br>(1) Concrete Noun and (2) Adjective | **اسماء النكرة:**<br>اسم ذات و اسم صفت |
| **Interrogative Nouns** | **اسماء استفهام** |
| **Adverbs:**<br>• Adverb of Time and Adverb of Place | **ظرف زمان / ظرف مكان** |

| | |
|---|---|
| **Compounds:**<br>Different constructions | **مرکّبات:**<br>**مرکب توصیفی - مرکب اضافی – مرکب اشاری – مرکب جاری - مرکب عددی** |
| **Gender:** Masculine and Feminine | **مذکر و مؤنث** |
| **Cases/Declension of Nouns:**<br>• Nominative Case<br>• Objective / Accusative Case<br>• The Genitive with Prepositions<br>• The Genitive of Possession<br>• Vocative Case | **إعراب:**<br>**مرفوع – منصوب – مجرور**<br>**(حالت رفعی – نصبی و جرّی)** |
| **Number:**<br>• Singular<br>• Dual<br>• Sound Plural (Masculine & Feminine)<br>• Broken Plural (and its Patterns) | **مفرد –**<br>**تثنیۃ /مُثنی**<br>**جمع مذکر سالم / جمع مؤنث سالم**<br>**الجمع التکسیر/ المکسر** |
| Collective Noun | **اسم جمع** |
| **Pronouns:**<br>• Personal Pronouns (Attached & Detached) | **الضمائرالمرفوعہ المنفصلۃ / المتصلۃ**<br>**الضمائرالمنصوبۃ المنفصلۃ / المتصلۃ**<br>**الضمائرالإضافیۃ:** ہ – ھما – ھم /<br>**الضمائرالمجرورۃ:** ہ – ھما - ھم |
| • Demonstrative Pronouns | **اسماء الإشارۃ:** ھذا - ھذہ – ھذان/ھذین – ھاتان/ھاتین – ھؤلاء /<br>ذلك - تلك – ذانك / ذينك / تانك/تينك - اولئك / ما – من |
| **Verbs:**<br>Present, Past & Future Tenses | **افعال:فعل ماضی** (تصریف) **– فعل مضارع** (تصریف و بناء)<br>**فعل أمر/ فعل نھی** (تصریف وبناء) |
| **Particles:**<br>• Prepositions, Conjunction, Interjection, Vocative and Interrogative particles | **حروف:**<br>**حرف جرّ، حرف عطف ، حروف نجائیۃ – حرف نداء – حرف سوال** |
| **Sentence:**<br>• Nominal Sentence & Verbal Sentence | **الجملۃ:**<br>**جملۃ اسمیۃ و جملۃ فعلیۃ** |
| **Counting**: (1-10) with things to be counted | **عدد – معدود** |
| **Diptotes and Triptotes** | **منصرف و غیر منصرف/الممنوع من الصرف** |
| **Recitation, Tajweed, Translation and Grammatical Analysis:** | |
| 01 Al-Fatiha (the Opening) | |
| 97. Al-Qadar (the Night of Decree) | |
| 98 Al-Bayinah (the Proof) | |
| 99. Az-Zilzal (the Earthquake) | |
| 100 Al-‘Adiyah (the Runners) | |
| 101. Al-Qari’ah (the Striking Hour) | |
| 102 At-Takathur (the Piling Up) | |
| 103. Al-‘Asr (the Time) | |
| 104. Al-Humazah (the Slanderer) | |

| |
|---|
| 105. Al-Fil (the Elephant) |
| 106 Quraish (Quraish) |
| 107. Al-Ma'un (the Assistance) |
| 108 Al-Kauthar (the River of Abundance) |
| 109. Al-Kafirun (the Disbelievers) |
| 110 An-Nasr (the Help) |
| 111. Al-Masad (the Palm Fiber) |
| 112 Al-Ikhlas (the Sincerity) |
| 113. Al-Falaq (the Daybreak) |
| 114 An-Nas(Mankind) |

**12.4 Semester 4**

**MACHINE DESIGN MT-253 (3, 0)**

**Objectives:**

To apply the engineering constraints and calculation on the components of machines.

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** concepts of Fits And Forms, Design Requirements of Machine Elements, Design Procedure, Standards in Design, Selection of Preferred Sizes, Selection of Materials for Static and Fatigue Loads, Factor of Safety. | C-2 | 1 |
| 2 | **Analyze** basic machine elements of keys, joints, screws and bearings. | C-4 | 2 |
| 3 | **Draw** assembly of various machine element under different loadings. | C-4 | 2 |

**Course outline:**

**Introduction:**
Definition, Understanding the Fits And Forms, Design Requirements of Machine Elements, Design Procedure, Standards in Design, Selection of Preferred Sizes, Selection of Materials for Static and Fatigue Loads. Design methodology; Design criterion based on fracture; Deformation and elastic stability design stresses; Factor of safety; Significant stress and significant strength; Stresses-concentration; Causes and mitigation; Endurance limit; Effect of concentration; Notch sensitivity; Size and surface finish; Goodman diagram; Gerber's parabola and Soderberg line.
**Manufacturing Consideration in Design**: Statistical Considerations, Selective Assembly, Design Consideration in Machining, Castings, Forgings, Welding.
**Design against Static Load**: Modes of Failure, Factor of Safety, Principal Stresses, Stresses Due to Bending and Torsion, Theories of Failure.
**Design Against Fluctuating Loads**: Cyclic Stresses, Fatigue and Endurance Limit, Stress Concentration Factor, Stress Concentration Factor for Various Machine Parts, Notch Sensitivity, Design for Finite and Infinite Life, Soderberg, Goodman Criteria.
**Design of Riveted Joints**: Types of Riveted Joints, Failure of Riveted Joint, Efficiency of Riveted Joint, Design of Boiler Joints, Eccentric Loaded Riveted Joint.
**Design of Threaded Joint**: Design of Bolted Joint, Eccentrically Loaded Bolted Joint.
**Power Screws:** Forms of Threads, Multiple Threads, Efficiency of Square Threads, Trapezoidal Threads, Stresses in Screws, Design of Screw Jack.
**Sliding Contact Bearing:** Types, Selection of Bearing, Plain Journal Bearing, Hydrodynamic Lubrication, Properties and Materials, Lubricants and Lubrication, Hydrodynamic Journal

Bearing, Heat Generation, Design of Journal Bearing, Thrust Bearing-Pivot and Collar Bearing, Hydrodynamic Thrust Bearing.

**Rolling Contact Bearing:** Advantages and Disadvantages, Types of Ball Bearing, Thrust Ball Bearing, Types of Roller Bearing, Selection of Radial Ball Bearing, Bearing Life, Selection of Roller Bearings, Dynamic Equivalent Load for Roller Contact Bearing Under Constant and Variable Loading, Reliability of Bearing, Selection of Rolling Contact Bearing, Lubrication of Ball and Roller Bearing, Mounting of Bearing.

**Assembly Drawing Of Machine Elements:**

Preparation of assembled views using parts details - Lathe tail stock - Lathe chuck - Connecting rod – Screw jack - Machine vice - Tool head of shaper.

Drawing shall be Made Wherever Necessary (Using CAD-Software Such as AutoCAD).

1. To Draw Orthographic projection Drawings (Front, Top and side) of boiler safety valve giving name the various components of the valve.
2. Make an Isometric dimensioned drawing of a connecting Rod using isometric grid and snap. Draw quarter sectional isometric view of a cotter joint
3. Design & Drawing of Knuckle Joint.
4. Design of Machine Components Subjected to Combined Steady and Variable Loads.
5. Design & Drawing of Eccentrically Loaded Riveted Joint.
6. Design & Drawing of Boiler Riveted Joint.
7. Design of Shaft Subjected to Fluctuating Loads.
8. Design of Screw Jack.
9. Design of Eccentrically Loaded Threaded Joint.
10. Design of Antifriction Bearing Assembly
11. Design of Journal Bearing
12. Design of Project Report Consists of Different Types of Bearings
13. Design of Cylinder and Cylinder Head.
14. Design of Piston, Piston Ring and Gudgeon Pin.
15. Design of Connecting Rod.
16. Design of Crankshafts.

**Recommended Books:**

1. Shigely Joseph E., “Mechanical Engineering Design”, McGraw-Hill Publications. (Latest Edition)
2. Valance Alex and Doughtie VI, “Design of Machine Members”, McGraw-Hill Co. (Latest Edition)
3. Spott M.F., “Machine design”, Prentice Hall India. (Latest Edition)
4. Maleev and Hartman, “Machine Design”, CBS Publications. (Latest Edition)
5. Black & Adams, “Machine design”, McGraw-Hill. (Latest Edition)
6. Sharma and Agrawal, “Machine Design”, S.K. Katara& Sons.
7. Bhandari V.B., “Design of Machine Elements”, Tata McGraw- Hill Co (Latest Edition)

**MACHINE DESIGN LAB MT-253L**

**COURSE OBJECTIVE:**

Understanding of fundamentals of CAD.2D and 3D modeling of machine component using Modelling software.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Practice** two & three dimensional machine components in CAD software. | P-3 | 5 |
| 2 | **Practice** assembly of machine components in CAD software. | P-3 | 5 |

**LAB OUTLINE:**
Two & Three Dimensional modeling of machine components using CAD software.

**FLUID MECHANICS MT-264 (2, 2)**

**Objectives:**

To enable the students to understand different properties of fluids in statics and kinematics and also will be familiar with flow and pressure measuring instruments.

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** concepts related to Fluid Statics and Fluid Kinematics. | C-2 | 1 |
| 2 | **Understand** principles related to fluid flow, similitude and dimensional analysis. | C-2 | 1 |
| 3 | **Solve** problems using principles and charts of Fluid Mechanics . | C-3 | 2 |

**Course Outline:**

**Introduction:**
Development of fluid dynamics, distinction between solid and fluid, gas and liquid, properties of fluids, Density, specific weight, specific volume, specific gravity, compressible and incompressible fluids, ideal fluids, viscosity and its units, surface tensions, vapor pressure of liquids etc.
**Fluid Statics:**

Pressure, variation of pressure in a static fluid, pressure head, review of types of pressures, pressure measurement gauges, Force on plane area, center of pressure, force on curved surface, Buoyancy and stability of submerged and floating bodies.

**Kinematics of Fluid Flow:**

Types of flow, flow rate and mean velocity, equation of continuity, flow net, velocity and acceleration in steady and unsteady flow.

**Measurement of flow rate velocity:**

Energy Consideration in Steady Flow: Kinetic energy of a flowing fluid, potential energy, internal energy, general equation for steady flow of any fluid, energy equation for steady flow of incompressible fluids. Bernoulli's theorem, Head, Power consideration in fluid flow cavitation's, energy equation for steady flow of compressed fluids, equation of steady motion along a steam line for ideal fluid and Euler's equation, equation of steady motion along a stream line for real fluid, Hydraulic gradient, energy line, problems, Pressure in fluid flow and its measurement, set trajectory, flow in a curved path, vortex, types of vortex.

**Similitude and Dimensional analysis:**

Definition and importance, geometrical, kinematic and dynamic similarity, dimensionless ratios, scale ratios, dimensional analysis.

**Steady & Incompressible Flow in Pressure conduits:**

Laminar and Turbulent flow, critical Reynolds number, hydraulic radius, general equation for friction, Darcy-Weisbach pipe friction equation, laminar flow in circular pipes, turbulent flow in circular pipes, pipe roughness, chart for friction factor, fluid friction in non-circular conduits, empirical equations for pipe flow. Flow measurements, Pitot tubes, venturimeter, orifices, nozzles.

**FLUID MECHANICS LAB MT-264L**

**OBJECTIVE:**

To demonstrate and develop understanding among the students about working principles of Fluid Mechanics with hands-on experience and to improve the psychomotor skills

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | Perform experiment & **Measure** key variables of interest (such as flow rate, coefficient of Drag, coefficient of velocity, coefficient of contraction, lift, power output and efficiency etc. | **P-5** | **4** |
| **2** | **Demonstrate** positive working attributes by working individually and working with a group. | **A-3** | **9** |

**Lab Outline:**

1. Study of Hydraulic Bench
2. To determine the co-efficient of Venturimeter & discuss its application.

3. To calibrate the given rectangular notch and discuss its application.
4. To calibrate a triangular notch and discuss its application.
5. To find the co-efficient of discharge
6. To calibrate the given pressure gauge & discuss its application.

**Recommended Books:**

1. Fluid Mechanics with Engg. Application by Daugherty and Franzini.(Latest Edition)
2. Fluid Mechanics by Victor L. Strecter. McGraw Hill (Latest Edition)
3. Fluid Mechanics and Hydraulic Machinery by K R Arora, Standard Publisher (Latest Edition)

**ENGINEERING STATICS MT-273 (2, 1)**

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Solve** problems related to vectors and scalars, conditions of equilibrium for particles and rigid bodies. | C-3 | 1 |
| 2 | **Analyze** structures such as trusses wedges and screws. | C-4 | 2 |
| 3 | **Understand** concepts of friction, center of gravity and moment of inertia. | C-2 | 1 |

**Course Outlines:**

**General Principles**

a. Introduction to the basic quantities and idealizations of mechanics.
b. Newton's laws of motion and gravitation
c. SI system of units.
d. Standard procedures for performing numerical calculations
e. General guide for solving problems

**Force Vectors**

a. Add forces and resolve them into components using the Parallelogram Law,
b. Express force and position in Cartesian vector form and determine vector's magnitude and direction
c. Introduce dot product to determine the angle between two vectors or projection of one vector onto another

**Equilibrium of a Particle**

a. Introduce concept of a particle free body diagram, solve particle equilibrium problems.
b. Force System Resultants a. Calculate moment of a force in two and three dimensions.
c. Find the moment of a about a specified axis, Define the moment of a couple.
d. Determine the resultants of no concurring force systems.
e. Reduce a simple distributed loading to a resultant force.

**Equilibrium of a Rigid Body**

a. Develop equations of equilibrium for a rigid body
b. Introduce the free-body diagram for a rigid body
c. Solve rigid-body equilibrium problems.

**Structural Analysis**

a. Determine forces in the members of a truss.
b. Analyze forces acting on pin-connected members of frames and machines.

**Internal Forces**

a. Determine the internal loadings in a member using the method of sections
b. Formulate equations that describe internal shear and moment throughout a member
c. Analyze forces and geometry of cables supporting a load

**Friction**

a. Analyze the equilibrium of rigid bodies subjected to dry friction
b. Present applications of frictional force analysis on wedges, screws, belts, and bearings
c. Investigate the concept of rolling friction

**Center of Gravity and Centroid**

a. Discuss the concept of center of gravity, center of mass, and the centroid
b. Determine the location of the center of gravity and centroid for a system of discrete particles
c. Find the area and volume for a body having axial symmetry using the Pappus and Guidinus theorems
d. Find the resultant of a general distributed loading and apply it to finding the resultant force of a pressure loading from a fluid

**Moments of Inertia**

a. Determine the moment of inertia for an area
b. Determine the minimum and maximum moments of inertia for an area using the product of inertia
c. Discuss the mass moment of inertia

**Recommended Books**

1. Engineering Mechanics: Statics, 12th Edition, Russell C.
2. Engineering Mechanics: Statics, 12th Edition, Hibbeler,
3. Engineering Mechanics: Statics, 12th Edition, Prentice Hall;

**ENGINEERING STATICS LAB MT-273L**

**OBJECTIVE:**

To gain basic understanding of various engineering structures in equilibrium.
To develop knowledge regarding physical phenomena in mathematical terms

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Perform** experiments to verify equilibrium conditions and Hook's Law. | **P-2** | **1** |
| **2** | Practice structural analysis of Jib-crane. | **P-3** | **1** |

**COURSE OUTLINE:**

1. To verify the principle of moments, which states that if a number of co-planar forces acting on a body, keep it in equilibrium and their moments are taken about any point in their pale, the sum of the clockwise moments is equal to the sum of the anticlockwise moments.
2. To determine the reaction of a beam under various loadings.
3. To verify the laws of friction between solid bodies and to find the coefficient of friction between wool and various other materials.
4. To find the tension in various parts of a hanging rope loaded at various points with various loadings.
5. To verify the law connecting the coefficient of friction between a cord and drum and angle of lap.
6. To resolve, by experiment, by suitable combination of three static, coplanar forces.
7. To compare the results with the graphical solution obtained by drawing triangle of forces diagram.
8. To illustrate the "resultant of two of the forces and to compare the magnitude and direction of its equal and opposite "equilibrant" with the experimental values.
9. If a system is in equilibrium under several co-planar concurrent forces: the forces on their free vectors must form a closed polygon
10. To verify the condition of (a) $\sum Fx = 0$ (b) $\sum Fy = 0$
11. Determine the forces acting in the members of a roof truss.
12. To determine the forces acting in the tie and the jib of simple jib (wall) crane.
13. To verify Hook's law for helical springs and to find their stiffness
14. To find the modulus of rigidity of helical springs using various spring balances.
15. To find the tension in various parts of a hanging rope loaded at various points with uniform loading conditions.

**PROBABILITY AND STATISTICS MS-213 (3, 0)**

**Objectives:**

The objective of the course is to familiarize the students with probability and different statistical terms and analysis.

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Understand** probability and random variables. | **C-2** | **1** |
| **2** | **Understand** probability distributions and curve fitting techniques. | **C-2** | **1** |
| **3** | **Understand** central limit theorem, autocorrelation and cross-correlations, power spectral density functions and stochastic processes. | **C-2** | **1** |

**Course Outline:**

1. Basic concept of probability, conditional probability, independent events, Baye's formula.
2. Concept of random variables, discrete and continuous one and two dimensional random
3. Variables, probability distributions, marginal and joint distributions and density functions.
4. Important probability distributions (Binomial, Poisson, Uniform, Normal, Exponentials and Hyper-geometric). Mean, variance, moments and moment generating functions, linear regression and curve fitting. Central limit theorem, autocorrelation and cross-correlations, power spectral density functions and stochastic processes.

**Recommended Books:**

1. J. Devore, Probability and Statistics, Latest Edition, John Wiley & Sons. (Latest Edition)
2. Ronal Walpole, Probability methods for engineering and scientists, Latest Edition, McGraw-Hill. (Latest Edition)
3. A. Popoulis and U, Pillai, Probability, Random Variable and Stochastic Processes, Latest Edition, McGraw-Hill, ISBN: 0071199810(Latest Edition)

**TOTAL QUALITY MANAGEMENT (TQM) MM-212 (2, 0)**

**Objectives:**

To enable the students understand the principles of Quality Management
To provide students details of quality planning and TQM techniques
To provide in depth knowledge of reliability and maintainability

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Explain** the different meanings of the quality concept and its influence. | **C-2** | **1** |
| **2** | **Analyze** several techniques and quality management tools. | **C-4** | **2** |
| **3** | **Explain** and differentiate the normalization, homologation and certification activities. | **C-3** | **1** |

**Course Outline:**

**Unit I Principle of Quality Management**
Definition of quality – Deming, Miller – Crosby Theories – Service and Product quality – Customer orientation. Evaluation of Total quality Management – Inspection – Quality Control – TQM System – Human component, Introduction to Six Sigma concepts.
**Unit II Quality Planning**
Planning – SMART Goal setting – Designing for Quality – Manufacturing for Quality – Process control – CPK – Process capability. Scientific Approach to TQM – Data based approach – Quantification – Statistical tools – Quality control tools – New 7 tools, Sampling and Control Charts.
**Unit III TQM Techniques Benchmarking**
Definition – Types – Steps – Metrics – Case studies – Quality Function Deployment – Definition – steps – Case studies – Corrective Techniques – Preventive techniques – Failure Mode and Effect Analysis – 5S. Continuous Improvement Techniques – Different techniques such as POKA YOKE etc. – Deming wheel – Case studies
**Unit IV Reliability Definition**
Control Charts Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts. Attributes of Control Charts Defects, construction and analysis off-chart, improvement by control chart, variable sample size, construction and analysis of C-chart. Unit-IV Defects Diagnosis and Prevention Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

**Recommended Books**

1. Dale H Besterfield, (2008), Total Quality Management,
Pearson Education
2. L.S. Srinath, (2005) Reliability Engineering, Affiliated East West
Press, New Delhi.

**Reference:**

1. Samuel K Ho, (1996), TQM – An Integrated Approach, II
Edition, Kogan Page Ltd., USA.
2. Joel E. Rose, (1993), Total Quality Management, II Edition,
Kogan Page Ltd., USA.

**TECHNICAL REPORT WRITING MH-223 (3, 0)**

**Objectives:**

The main objective of the course is to help students learn the basic concepts in technical writing and familiarize students with standard templates used in modern technical documents.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** concepts related to essay and technical report writing. | C-2 | 1 |
| 2 | **Communicate** by applying understanding of Technical Report. | C-3 | 10 |
| 3 | **Understand** process of planning, drafting and finishing document. | C-2 | 1 |

**Course Outline:**

Essay writing: Descriptive, narrative, discursive, argumentative. Academic writing: How to write a proposal for research paper/term paper. How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency). Technical Report writing. Progress report writing. Technical document creation with tools and technique to improve quality. Structure, layout and writing style for various technical documents for both print and digital media. Document review process and assessment of written report and documents. Technical Communication Basics, A General Definition of Technical Communication, Major Traits of Technical Communication, Globalization and Cultural Awareness. The Technical Communication Process. An Overview of the Process, Planning Document, Drafting and Finishing Document, Editing. The Uses of Visual Aids, Planning the Mechanism Description, Writing the Mechanism Description. The Elements of a Formal Report, Planning the Recommendation Report, Drafting

the Recommendation Report, Planning the Feasibility Report, Writing the Feasibility Report, Ethics and Proposals. Writing the Internal Proposal, Planning the Manual, Writing the Manual, Making an Effective Presentation.

**Recommended Books:**

1. “Technical Report Writing Today” by Daniel Riordan, 10th Edition
2. “Technical Writing and Professional Communication”, Leslie Olsen and Thomas Huckin, 2nd Edition

**12.5 Semester 5**

**HEAT TRANSFER MT-313 (2, 1)**

**Objectives:**

The objective of the course is to familiarize the students with different modes of heat transfer.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Comprehend** modes of heat transfer by understanding principles governing of steady state conduction, convection and radiation. | C-2 | 1 |
| 2 | **Apply** concepts of modes to calculate heat transfer through walls and heat exchangers | C-3 | 1 |

**Course Outline:**

**UNIT 1: Introduction**
a. Conduction Heat Transfer
b. Thermal Conductivity
c. Convection Heat Transfer
d. Radiation Heat Transfer
e. Dimensions and Units

**UNIT 2: Steady-State Conduction (One Dimension)**
a. Introduction
b. The Plane Wall
c. Insulation and R- Values
d. Radial Systems
e. The Overall Heat-Transfer Coefficient
f. Critical Thickness of Insulation
g. Heat-Source Systems
h. Cylinder with Heat Sources
i. Conduction-Convection Systems
j. Fins
k. Thermal Contact Resistance

**UNIT 3: Principles of Convection**
a. Introduction
b. Viscous Flow
c. In viscid Flow
d. Laminar Boundary Layer on a Flat Plate

e. Energy Equation of the Boundary Layer
f. The Thermal Boundary Layer
g. The Relation Between Fluid Friction and Heat Transfer

**UNIT 4: Radiation Heat Transfer**

a. Introduction
b. Physical Mechanism
c. Radiation Properties
d. Radiation Shape Factor
e. Relations Between Shape Factors
f. Heat Exchange between Nonblack bodies
g. Infinite Parallel Surfaces
h. Radiation Shields
i. Gas Radiation
j. Radiation Network for an Absorbing and Transmitting Medium
k. Radiation Exchange with Specular Surfaces
l. Radiation Exchange with Transmitting, Reflecting, and Absorbing Media
m. Formulation for Numerical Solution
n. Solar Radiation
o. Radiation Properties of the Environment
p. Effect of Radiation on Temperature Measurement
q. The Radiation Heat-Transfer Coefficient

**UNIT 5: Heat Exchangers**

a. Introduction
b. The Overall Heat-Transfer Coefficient
c. Fouling Factors
d. Types of Heat Exchangers
e. The Log Mean Temperature Difference
f. Effectiveness-NTU Method
g. Compact Heat Exchangers
h. Analysis for Variable Properties
i. Heat-Exchanger Design Consideration

**Recommended Books:**

1. Heat transfer by j.p holman (latest edition)
2. Heat and mass transfer by frank p.incropera, david p. dewitt
(latest edition)

**HEAT TRANSFER LAB MT-313L**

**OBJECTIVE:**

The course covers the Basic and advance Heat and Mass Transfer using experimental approach to understand the Fourier law for conduction and convection. The course also covers the experimental determination of the log mean temperature difference for different types of heat

exchanges.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | To **Practice** multiple Heat Transfer testing under different setting and control system to investigate the effect of heat transfer. | **P-3** | **4** |
| **2** | **Contribute** to lab activities individually as well as in group. | **A-2** | **9** |

**COURSE OUTLINE:**

1. Fourier's law study for linear conduction of heat along a homogenous bar
2. Conduction of heat and overall heat transfer along a composite bar
3. The effect of a change in cross sectional area on the temperature profile along a thermal conduct
4. Temperature distribution for steady state conduction of heat through the wall of a thick disk
5. Fourier's rate equation in determining the rate of heat flow through wall of a thick disk
6. Determination of the relationship between power input and surface temperature in free convection for flat type heat exchanger
7. Determination of the relationship between Input velocity and surface temperature in force convection for flat type heat exchanger
8. Determination of the relationship between power input and surface temperature in free convection for pinned heat sink type heat exchanger
9. Determination of the relationship between Input velocity and surface temperature in force convection for pinned heat sink heat exchanger Determination of the relationship between power input and surface temperature in free
10. convection for fin type heat exchanger
11. Determination of the relationship between Input velocity and surface temperature in force convection for fin type heat exchanger
12. Determination of logarithmic average of the temperature difference for double pipe type heat exchanger for parallel flow
13. Determination of logarithmic average of the temperature difference for double pipe type heat exchanger for counter flow
14. Determination of logarithmic average of the temperature difference for flat plate type heat exchanger for parallel flow
15. Determination of logarithmic average of the temperature difference for flat plate type heat exchanger for counter flow
16. Determination of logarithmic average of the temperature difference for shell and tube type heat exchanger for parallel flow

17. Determination of logarithmic average of the temperature difference for shell and tube type heat exchanger for counter flow
18. Determination of thermal conductivity of liquids and Gases

**REFERENCE BOOK:**

Heat Transfer, a Practical Approach By Y. A. Cengel, McGraw-Hill

**I. C. ENGINE MT-324 (2, 2)**

**Objectives:**

The objective of the course is to familiarize the students with the construction and working of different sub systems of I.C. engine

**CLOs**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Apply** various thermodynamic cycles related to internal combustion engines and analyze combustion processes in engines. | C-3 | 1 |
| 2 | **Understand** working of supercharged engines, engine cooling and fuel injection systems. | C-2 | 1 |
| 3 | **Understand** efficiency and criteria of selection of IC Engines. | C-2 | 1 |

**Course Outline:**

**Thermodynamics of actual working fluids:** Working fluid before combustion, valve and port timing diagrams. Thermodynamic properties of fuel-air mixture before combustion. Use of combustion charts for unburned mixture. Use of combustion charts for burned mixture. Appropriate treatment of fuel air mixtures. Fuel air cycles: Definition
constants, volume fuel air cycle, limited pressure cycle, characteristics of fuel-air cycles, comparison of real and fuel cycles.
**Air capacity of four stroke engines:** Ideal air capacity, Volumetric efficiency, ideal induction process , actual induction process, Effect of operating conditions on volumetric efficiency, Effect of design on volumetric efficiency , estimating air capacity.
**Two stroke engines:** Scavenging process, ideal scavenging process, relationship of scavenging ratio and scavenging efficiency, power to scavenger, supercharged two stroke engines. chemistry of combustion, normal combustion in S.I engines , pre-ignition and auto-ignition comparison, detonation in S.I engines, combustion in C.I engines, detonation in C.I engines, Methods of reducing detonation , preliminary detonation, preliminary facts about fuel and dopes, octane and cetane numbers, effect of design on detonation.

**Mixture requirements:** Steady running, mixture requirements, transient mixture requirements, mixtures requirements for fuel injection engines, mixture requirements for S.I engines.
**Performance of supercharged engines:** engine performance measures, commercial engine ratings, basic performance equations for un-supercharged engines, effect of atmospheric conditions, altitude and compression ratio on performance characteristics, performance curves.
**Supercharged engines:** definitions, reasons for supercharging, supercharging of S.I engines, Supercharging of diesel engines.
**Heat losses and cooling:** Area of heat flow engines, temperature profile, Engine cooling system, Numerical on heat transfer in I.C engines.
**Engine design:** selection of type, engine speed and principles of similitude. Numerical on alternative fuels, Numerical on diesel fuel injection system, Numericals on engine specification and verification, Numerical on two stroke engines.
**General design of petrol and diesel engine:** Numericals on engine design, determination of main dimensions, Comparative Numerical on two stroke engines and four stroke engines.

**I. C. ENGINE LAB MT-324L**

**OBJECTIVE:**

To learn fundamentals of I.C Engines and basic terminologies.
To learn automobiles systems and technologies.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Explain** the variation in mixture of air and fuel and its resultant impact on efficiency of combustion process. | **P-2** | **4** |
| **2** | **Explain** PV diagram as generated by varying the torque and rpm of I.C. Engine apparatus. | **P-2** | **4** |

**LAB OUTLINE.**

1. Study of two stroke spark ignition engine model.
2. Study of four stroke spark ignition engine model.
3. Study of four stroke diesel engine model.
4. Study of rotary wankel engine.
5. Study of models of gas turbine engines.
6. Study of single cylinder four stroke direct injection diesel engine. (cut section )
7. Study of multi-cylinder optical spark ignition engine.
8. Experimental study of characteristic performance curves of spark ignition engine using gasoline as fuel.
9. Experimental study of characteristic performance curves of compression ignition engine using diesel as fuel.

10. Experimental study of characteristic performance curves of compression ignition engine using biodiesel blends, with diesel as fuel.
11. Study of engine components. (like cylinder block , crank shaft etc ).
12. Study of components of ignition system of S.I. Engines.

**Recommended Books:**


1. Domkundvar V.M., "A course in internal combustion engines", Dhanpat Rai and company, New Delhi, 1999.


**DYNAMICS MT-333 (2, 1)**

**OBJECTIVES:**

To gain fundamental concepts of bodies under dynamic conditions
To implement laws of motions to components/structures under the influence of forces.

**CLO:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Describe** key concepts related to position, velocity and acceleration in Cartesian, Normal and Tangential and Polar Coordinate Systems, kinetics, work and energy for particles and rigid bodies. | **C-2** | **1** |
| **2** | **Analyze** the problems related to kinematics of particles and rigid bodies using different coordinate systems. | **C-4** | **2** |
| **3** | **Analyze** the problems related to Kinetics of rigid bodies using different principles and techniques for their solution. | **C-4** | **2** |

**Course Outline:**

1. Kinematics of Particles. Rectilinear motion, plane curvilinear motion, rectangular coordinates, normal and tangential coordinates polar coordinates. Kinetics of Particles.
2. Force, mass, and acceleration, Newton's second law of motion, equations of motion, kinetic diagrams, rectilinear motion, curvilinear motion.
3. Work and energy, potential energy. Impulse and momentum, conservation of momentum. Plane Kinematics of Rigid Bodies.
4. Angular motion relations, absolute motion, relative velocity, instantaneous center of zero velocity, relative acceleration.

5. Plane Kinetics of Rigid Bodies: Force, mass, and acceleration, equation of motion, translation, fixed axis rotation, general plane motion, work and energy relationship, impulse and momentum equation.

**DYNAMICS LAB MT-333L**

**OBJECTIVE:**

To gain fundamental concepts of bodies under dynamic conditions .
To implement laws of motions to components/structures under the influence of forces.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Perform** experiments and find out unknowns such as forces, moments, positions and velocities etc. | **P-2** | **3** |
| **2** | **Compare** theoretical values of variables of concern with experimental values. | **P-1** | **4** |

**Lab Outline**:

1. To determine Mechanical Advantage of Inclined Plane. To compare Actual and Ideal Mechanical Advantage.
2. To compare actual and ideal mechanical advantage of inclined plane. To derive relationship between angle and mechanical advantage (actual and ideal) at different angles.
3. To determine the mechanical advantage of screw jack.
4. To compare efficiencies and M.A of square and v-thread. To draw relationship between n and M.A with the help of graph.
5. To compare efficiencies and M.A of square and v-thread. To draw relationship between efficiency and Mechanical Advantage with the help of graph.
6. To determine Moment of Inertia of fly wheel by free falling method.
7. To verify the relationship between angular and linear velocity
8. To find tension in jib and tie of derrick crane. To compare experimental and graphical value: To find the velocity ratio, mechanical advantage and load lost in friction and the efficiency of worm and worm wheel.
9. To find the velocity ratio, mechanical advantage and the load lost in friction and the efficiencies of a western differential pulley.

**Recommended Books**:

1. Vector Mechanics for Engineers (Dynamics) by Beer and Johnston (Latest Edition)
2. Engineering Mechanics (Dynamics) by J. L. Meriam (Latest Edition)
3. Engineering Mechanics (Dynamics) by R. C. Hibbler (Latest Edition)

**MANUFACTURING PROCESSES MT-343 (2, 1)**

**COURSE OBJECTIVES**

Enable the student to know about different types of machine tools & processes used in production/manufacturing.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamental concepts and principals of advanced manufacturing processes and safety. | C-2 | 1 |
| 2 | **Understand** concepts related to Material Removal, Foundry, Cold Working and Hot Working, and Machine Tools and Processes. | C-2 | 1 |
| 3 | **Analyze** the problems related to Kinetics of rigid bodies using different principles and techniques for their solution. | C-4 | 2 |

**Course Outline**

**Introduction:**
Introduction to Manufacturing Processes and their Classification, Industrial Safety; Introduction, Types of Accidents, Causes and Common Sources of Accidents, Methods of Safety, First Aid.
**Material Removal:**
Mechanics of chips formation, Types of chips produced, Chip breakers, Orthogonal & Oblique cutting, Cutting forces in conventional turning, Friction & heat sources in cutting, surface finishing processes, Lapping, Honing, Super finishing, Polishing, Buffing, Electroplating, Galvanizing, Metal spraying
**Foundry:**
Introduction to Casting Processes, Basic Steps in Casting Process, Pattern, Types of Patterns, Pattern Allowances, Risers, Runners, Gates, Moulding Sand and its composition, Sand Preparation, Molding Methods, Core Sands and Core Making, Core Assembly, Mold Assembly, Melting ( Cupola) and Pouring, Fettling, Casting Defects and Remedies.
**Cold Working& Hot Working processes**:
Sheet Metal Operations, Measuring, Layout Marking, Shearing, Punching, Blanking, Piercing, Forming, Bending and Joining Advantages and Limitations. Hot Working Processes: Introduction to Hot Working, Principles of Hot Working Processes, Forging, Rolling, Extrusion, Wire Drawing,
**Introduction to Machine Tools& Processes:**
Specifications and Uses of commonly used Machine Tools in a Workshop such as Lathe, Shaper, Planer, Milling, Drilling, Slotter, Introduction to Metal Cutting. Nomenclature of a Single Points Cutting Tool and Tool Wear. Mechanics of Chips Formations, Type of Chips , Use of Coolants in

machining. Broaching & broaching machines, Press machine, Types of Press machines, Press work operations.
**Jigs & Fixtures:** General Design principle, Elements of Jig, Locating Devices & Clamping Devices

**MANUFACTURING PROCESSES LAB MT-343L**

**OBJECTIVE:**

To get familiar with basic operations of spot welding, oxyacetylene welding, foundry, power press, bending machine, roller machine and rivet gun.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Copy** basic operations of power press, bending machine, roller machine and foundry. | **P-3** | **4** |
| **2** | Manufacture **more accurate** simple jigs, clamping and locating devices. | **P-5** | **4** |

**Lab Outline**:

1. Study of lathe, milling, boring and drilling machine.
2. Practice on press machines.
3. Chips formations and their types .
4. Basic casting and its types, making patterns and moulds
5. Study about die casting and core molding .
6. Bending sheet metals of different thickness.
7. Practice on making of simple jigs, clamping and locating devices.
8. Forging and rolling extrusion process.

**Reference:**

1**.** Manufacturing Science – Amitabh Ghosh& Ashok Kumar Malik, - East-West Press. (Latest Edition)
2. Manufacturing Process and Systems - Ostwald, Munoz, John Wiley.
3. Workshop Technology, Vol. 1, 2 & 3 – Chapman, WAJ, Edward Arnold (Latest Edition)
**Recommended Books:**

1. Workshop Technology Vol. I & II – Hazra & Chaudhary, Asian Book Comp., New Delhi. (Latest Edition). Process and Materials of Manufacture -- Lindberg,
2. R.A. Prentice Hall of India, New Delhi. (Latest Edition)
3. Principles of Manufacturing Materials and Processes - Campbell, J.S. – Mc Graw-Hill. (Latest Edition)

**PROJECT MANAGEMENT MM 313 (3, 0)**

**Objectives:**

- To understand modern project management techniques related government regulations.
- To implement modern project management techniques using software.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamental concepts of project proposals, project life cycle, project planning and project organization. | C-2 | 11 |
| 2 | **Apply** work breakdown structures to solve problems. | C-3 | 11 |
| 3 | **Understand** basics of project risk analysis techniques. | C-2 | 11 |

**Course Outline:**

Fundamental principles, project proposals and feasibilities, 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 Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner, John Wiley
2. Case studies in project management, 2nd Edition, by Harold Kerzner, John Wiley
3. Project Management Body of Knowledge (PMBOK) 4th Edition, by P. M.I.

**Economics (MH-312)**

**CLO's:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamental concepts related to engineering costs, time value of money and rate of return. | C-2 | 1 |
| 2 | **Understand** concepts related to payback period, depreciation, taxation, and import and exports. | C-2 | 1 |
| 3 | **Solve** problems of replacement analysis, risk and uncertainty associated with engineering economics. | C-3 | 1 |

**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**

   d. Benefit and cost ratio (B/C Ratio), discounted benefit and cost ratio
   e. Simple payback period, discounted payback period
   f. Sensitivity & breakeven analysis
   g. Principle of comparative advantage

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

a. Income Taxes, After tax RoR

6. Replacement analysis
    a. Design life, salvage value
    b. Up gradation Vs replacement
7. Risk and Uncertainty
    a. Estimation of future events
    b. Monte Carlo Simulation
    c. Bayes theorem
8. Concepts of Imports and Exports
    a. Basic concepts of import and export
    b. Dumping and anti-dumping and related laws

## 12.6 Semester 6

**INSTRUMENTATION AND CONTROL MT-353( 2, 1)**

**Objectives:**

Enable the students to know about basics of control system & measuring instruments.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Make** mathematical models of different physical systems. | C-4 | 2 |
| 2 | **Analyze** complex engineering systems to examine different characteristics/properties of the systems. | C-4 | 2 |
| 3 | **Develop** a controller to achieve desired system response. | C-3 | 3 |

**Course Outline:**

1. Introduction to control system, input & output, open loop, closed loop control system & feedback control system, Elements of a general control system &their examples, transfer function.
2. Transducers, classification of Transducers.
3. Study of different indicating, measuring & recording instruments for length force, torque, frequency, pressure, flow & temperature.

4. Free body Diagram and Newton's law of motion, operational notation, grounded chair representation, series & parallel laws. Equation of motion for a spring mass & damper system, Electrical & Mechanical analogous circuits. Concept, routh criterion & root locus method for stability measurements.

**INSTRUMENTATION AND CONTROL LAB MT-353L**

**OBJECTIVE:**

The objective of this course is to verify the working of different types of electronic devices including PLC, Arduino, Gates combinations, Strain gauges, Flexible Manufacturing System, Transistors and Rotational speed and position measure devices. How to use electronic and mechanical devices at same place to control mechanical system automatically.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | Perform and **Measure** the experimental values of different unknowns using different measurement systems. | **P-5** | **4** |
| **2** | **Demonstrate** positive working attributes by working individually and with a group. | **A-3** | **9** |
| **3** | Perform and **Measure** the experimental values of different unknowns using different measurement systems. | **P-5** | **4** |

**Lab outline:**

1. Experimental Determination of Transfer function of a given mech system.
2. Experimental study of different types of pressure measuring devices
3. Experimental study of different types of temperature measuring devices
4. Use of oscilloscopes.

**Recommended Books:**

1. Automatic control by Francis H Raven (Latest Edition)
2. Modern control system by Richard C dorf (Latest Edition)
3. Automatic control by J.J Distofanoelef. (Latest Edition)

**MECHANICAL VIBRATION MT-363 (2, 1)**

**Objectives**

1.Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions,
2.Be able to make free and forced (harmonic, periodic, non-periodic vibration analysis of single and multi-degree of freedom linear systems
3.Be able to write the differential equation of motion of vibratory systems.

Be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF,MDOF)

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamental concepts of vibrations and mathematical modelling of different types of vibration system. | C-2 | 1 |
| 2 | **Solve** problems related to different mechanical translational, rotational and other applications. | C-3 | 2 |
| 3 | **Design** and analyze the system response by using the different techniques of Mechanical Vibrations with the application of mathematical modeling. | C-6 | 3 |

**Course Outline:**

Fundamental concepts in vibration and modeling: Introduction to modeling and analysis Introduction to mechanical vibration. Free vibration of single degree of freedom systems: Un-damped vibration; Simple harmonic motion; Damped vibration; Modeling: Energy and Newton's methods; Measurement of vibration components; Design Consideration; Stability Forced harmonic excitation of single degree of freedom systems: Un-damped vibration; Damped vibration; Base excitation; Rotating unbalance; Coulomb damping Vibration of single degree of freedom systems under general forcing
conditions: Impulsive inputs; Arbitrary non-periodic inputs; Arbitrary periodic inputs; Stability Vibration of multi degree of freedom systems: Modeling, Free un-damped vibration; Eigenvalue problem; Modal analysis; Free damped vibration; Forced vibration Dynamic vibration absorbers; Isolators for shock and harmonic loading.

**Recommended Books:**

1. Thomson W.T., and Dahleh M.D., Theory of Vibrations with Applications, Pearson Education. (Latest Edition)
2. Palm W.J., Mechanical Vibration, Wiley Publishers. (Latest Edition)
3. Tongue B.H., Principles of Vibration, Oxford University Press. (Latest Edition)
4. Meirovitch L., Fundamentals of Vibrations, McGraw-Hill. (Latest Edition)
5. Kelly G.S., Mechanical Vibrations: Theory and Applications, CL-Engineering Publication. (Latest Edition)
6. Rao S.S., Mechanical Vibration, Prentice Hall. (Latest Edition)
7. Rao J.S., Advanced Theory of Vibration, New Age International. (Latest Edition)
8. Mukhopadhyay M., Structural Dynamics: Vibrations and Systems, ANE Books. (Latest Edition)
9. McConnell K.G., and Varoto P.S., Vibration Testing: Theory and Practice, Wiley. (Latest Edition)
Timoshenko S., Vibration problems in engineering, Oxford University Press. (Latest Edition)

**MECHANICAL VIBRATION LAB MT-363L**

**OBJECTIVE:**

To study and visualize the different ways of vibration occurrences in mechanical equipment and how to control it, i.e. whirling of shafts, spring damper systems etc.

**CLOs:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | Operate & **Measure** different apparatuses to find key variables such as period of oscillations & natural frequency etc. | **P-5** | **4** |
| **2** | **Contribute** effectively to the assigned task by working individually and in a group | **A-2** | **9** |
| **3** | Operate & **Measure** different apparatuses to find key variables such as period of oscillations & natural frequency etc. | **P-5** | **4** |

**LAB OUTLINE:**

1. Determination of the period of oscillation for bifilar suspension system.
2. Determination of the period of oscillation and mass moment of inertia for trifilar suspension.
3. Determination of the rotational inertia of point masses and rod.
4. Determination of the rotational inertia of disc.
5. Determination of the rotational inertia of ring.
6. To demonstrate universal vibration apparatus.
7. To demonstrate natural undammed free vibration on universal vibration apparatus.
8. To demonstrate dammed forced vibration on universal vibration apparatus.
9. To illustrate the experimental method of scientific investigation by finding how the period of a pendulum depends on various factors.
10. Determination of the period of torsional vibration as a function of: Torsion wire diameter And Torsion wire length.
11. Determination of the natural frequency, of a spiral spring-rotating mass system.
12. To determine whirling speed of shaft theoretically and experimentally.
13. Determination of static and dynamic unbalances.
14. Balancing the apparatus statically and dynamically.

**REFRIGERATION & AIR CONDITIONING MT-373 (2, 1)**

**Objectives:**

The objective of the course is to familiarize the students with the refrigeration and air-conditioning cycles and its construction and working.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamental concepts related to thermodynamics and Refrigeration & Air Conditioning including Psychometry, vapor absorption and compression systems. | C-2 | 1 |
| 2 | **Solve** problems using fundamental concepts, formulae, and Psychometry charts. | C-3 | 2 |
| 3 | **Understand** selection criteria of refrigerant including its impact on environment and safety procedures related to a refrigerant | C-2 | 7 |

**Course Outline:**

**UNIT 1: Introduction**

Introduction to refrigeration, History of refrigeration, thermodynamic system, path and point functions, thermodynamic process, cycle, heat, work , State the four fundamental laws of thermodynamics , Apply first law of thermodynamics to closed and open systems and develop relevant equations , internal energy and enthalpy

Discuss the importance of second law of thermodynamics and state Carnot theorems. Define and distinguish the differences between heat engine, refrigerator and heat pump ,

Obtain expressions for Carnot efficiency of heat engine, refrigerator and heat pump, State Claudius inequality and introduce the property 'entropy'

**UNIT 2: Refrigeration Machines and reversed Carnot cycle**

Refrigeration machine, The Carnot cycle, Vapor as refrigerant in Reversed Carnot cycle, Gas as refrigerant in Reversed Carnot cycle, Limitation of Reversed Carnot cycle, COP

**UNIT 3: Vapor compression System**

Modification in Reversed Carnot cycle with Vapor as a refrigerant, Vapor compression cycle, Wet and Dry compression, Actual Vapor compression cycle, Pressure-Enthalpy diagram, Simple saturated cycle on P-H diagram, Co-Efficient of performance and Energy Efficiency Ratio,(EER),Heat of compression, Work of compression and the heat of rejection

**UNIT 5: Vapor Absorption System**

Simple Vapor Absorption system, Maximum Coefficient of performance of a heat operated Refrigeration machine, Common Refrigeration-Absorption systems, water and lithium bromide absorption system, Single effect and double effect absorption cycle

**UNIT 6: Psychrometry**

Psychrometry, Properties of Air, water vapor in the air, Relationship between pressure of air and pressure of water vapor, Humidity, Temperature, Dew point and Wet bulb Depression, Enthalpy of Moist air, Adiabatic saturation of air, Relationship between humidity ratio and dry bulb and wet bulb temperature, specific volume of moist air, Specific heat of moist air, Psychometric chart, Sensible heating and cooling, Heating with humidification, cooling with dehumidification, By Pass factor, Sensible Heat factor

**UNIT 7: Refrigerant**

Introduction of refrigerant, Development of refrigerant. Classification of refrigerant, Designation of refrigerant, Requirement of selection of refrigerant, Safety procedure, common refrigerant

**UNIT 8: Application of Refrigeration and Air condition**

Cold storage, Ice Making, Window type AC, Split AC, Package Type, Cooling Towers, Air washers, Chiller

**Reference:**

1. ASHRAE Guide.

**Recommended Books:**

1. Principles of Refrigeration by R. J. Dosset (Latest Edition)
2. Refrigeration and Air Conditioning by Jordan and Priester (Latest Edition)
3. Refrigeration and Air Conditioning by W.F. Stocker. (Latest Edition)
4. Refrigeration and Air Conditioning by CP Arora (Latest Edition)

**REFRIGERATION & AIR CONDITIONING Lab MT-373L**

**OBJECTIVE:**

To demonstrate and develop understanding among the students about the basic working principles of HVAC with hands-on experience and to improve the psychomotor skills

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Regulate** & measure different settings and parameters of multiple RAC testing units to observe different properties of air and refrigerants after heating or cooling processes. | **P-5** | **4** |
| **2** | **Contribute** effectively to the assigned task by working individually and in a group | **A-2** | **9** |
| **3** | **Regulate** & measure different settings and parameters of multiple RAC testing units to observe different properties of air and refrigerants after heating or cooling processes. | **P-5** | **4** |

**LAB OUTLINE:**

1. To carry out the thermodynamic analysis of the Simple Compression Refrigeration Cycle
2. Study of characteristics of automotive refrigeration cycle and to find coefficient of performance.
3. Demonstration and Working of reverse air conditioning system and to find coefficient of performance.
4. Demonstration and working of Vapor Absorption Refrigeration System
5. Demonstration and working of Air Conditioning Laboratory Unit
6. Study of characteristics of air on psychometric chart and to draw refrigeration cycle
7. Study of characteristics of air on psychometricchart and to draw refrigeration cycle in recirculating air conditioning unit
8. General Observation of the Forced Draught Cooling Tower.
9. Investigation of the Effect of Cooling Load on Wet Bulb Approach.
10. Investigation of the Relationship between Cooling Load and Cooling Range.
11. Determination of power input, heat output and coefficient of performance of Mechanical Heat Pump
12. Production of heat pump performance curves over a range of source and delivery temperatures of Mechanical Heat Pump

**MATERIAL HANDLING AND SAFETY MT-384 (3, 1)**

**Objectives:**

After going through this subject the student will be able to know about the various types of conventional material handling equipment's along with modern and latest equipment and devices e.g: AGVs, Robots, Pallet trucks, different types of electronic sensor using devices etc.

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| 1 | **Understand** fundamental concepts related to material handling and safety management. | C-2 | 1 |
| 2 | **Understand** handling of various mechanical machines and systems. | C-2 | 1 |
| 3 | **Use** concepts of material handling and safety for different situations and possibilities. | C-3 | 1 |

**Course Outline:**

1. The material-handling problem
2. Introduction, Material Handling Equipment Marketing, Principles of material handling, factors affecting material handling
3. Bulk-Material-Handling Equipment
4. Belt Conveyers, Bucket Elevators and Bucket Conveyers, Screw Conveyers, Vibratory Conveyers, Feeders and Screws, Vehicle Bulk-Handling Systems, Marine Bulk-Material Handling.
5. Packaged-Material-Handling Equipment
6. Pallets and Palletizing Operations, Package and Unit Conveyer Systems, Belt Package Conveyer
7. Power Roller conveyer, Conveyer Turns and Switches, Conveyer Sortation and Accumulation Systems, Pallet Conveyers.
8. Monorail conveyer Systems
9. Light Duty Chain and Cable System, Heavy Duty Systems, Power-and-Free Systems, Powered-Carrier Monorail Systems
10. Counterbalanced Forklift Trucks.

11. Reach-Type Non-Aisle Forklift Trucks, Narrow-Aisle Turret-Type Forklift Trucks, Side-Loading Forklift Trucks,
12. Miscellaneous Material Handling Equipment
13. Vehicular Unit Handling equipment, Pallet Transporters and Material Handling Tools. Towline Systems, Tractor-Trailer Trains.
14. Integrated Material Handling Systems
15. Automated Guided Vehicles and Their Applications, Use of Robots
16. Classification of Health hazards. Physical, chemical, biological. Sources of risk
17. Machinery Noise, Electrical failure, ventilation, lighting, radiation
18. Dangerous substances
19. Classification, Entry & Exit routes, safe handling, Health & safety regulation & policy.
20. Safety Machining & Guarding,
21. Preventing Machining accidents, Machine guarding
22. Equipment & Machine handling
23. Mechanical & Manual Handling, Access Equipment, Transport, Electricity & Electrical Equipment.
24. Fire:-Classification, fire protection, means of Escape, Actions to be taken. Chemical safety Personal protection.
25. Safety Management Accident prevention, health & safety training, communicating safety measures.

**MATERIAL HANDLING AND SAFETY MT-384 L**

**CLOS:**

| CLO | Description | Level | PLO |
|---|---|---|---|
| **1** | **Identify** hazards during operating machines. | **P-2** | **4** |
| **2** | **Contribute** effectively to the assigned task by working individually and in a group | **A-2** | **9** |

**Reference:**

1. Langford J. W. “LOGISTICS PRINCIPLES AND APPLICATIONS”. McGraw Hill, UK. (Latest Edition)

**Recommended Book:**

1 Sims Jr. E.R. “planning and managing industrial logistics systems” Elseveir, Amsterdam. (Latest Edition)

2. Maynard‟s „industrial engineering handbook” McGraw Hill, (Latest Edition)
3. Holt A.S.J Principle of Health & safety at work. The institution of occupational safety & health. The caverdisk press Limited. UK 1999.
4. Patty F.A "Industrial Hygiene & Toxicology Vol-1 General Principles" Inter science Publishers New York. (Latest Edition)

**PROJECT MT-393 (0, 3)**

**Objectives:**

To develop the ability of exercising the problem analysis, design & its validation, prototype production on economical scale.

**Course Outline:**

Project work is basically to complement Engineering Technology study. The student is in close consultation with department faculty will complete the project using Library,

Computer or Laboratory facilities. It shall be considered as Engineering Technology Subject to a minimum of 06 Credit Hours work that entails the following activities in general:-

1. Detailed problem analysis
2. Project timeline Schedule
3. Literature Review
4. Conceptual and actual Design
5. Design validation
6. Material selection
7. Manufacturing / Fabrication ( Economical Prototype / Model production if required)
8. Assembly, test & Trials and logging of results
9. Report writing and presentation

**Note:**

The student(s) to undertake project during 6th semester and its following summer. Six credit hours academic work be undertaken as follows:-

1. Three credit hours work during 6th Semester under the guidance of departmental faculty. The work that entails supervised work entails problem analysis, timeline & Schedule, Literature Review, conceptual / Actual design, design validation and material selection.
2. Three credit hours during summer where student(s) will work independently and may seek guidance from the concerned Faculty / Project Supervisor. The independent working of student(s) entails Manufacturing / Fabrication ( Economical Prototype / Model production if required), Assembly, test & Trials and logging of results, Report writing and presentation.

**12.7 Semester 7-8**

**16+16 week supervised Industrial/Field training MT-4116(0, 16), MT-42116 (0, 16)**

**Background:**

Industrial Training refers to students' work experience in an engineering- practice environment to familiarize themselves with professional engineering practices prior to graduation as BSc engineering Technologist. The training curriculum consists of 32 weeks of continuous industrial/field training @ 8 hours working / day and 5 working days a week. BSc Engineering Technology Student shall undergo this Industrial Training during the 7th and 8th semester after he/ she has passed all subjects up to 6th semester. This Training covers a range of activities, such as design implementation, production processes, laboratory, on-site field works and maintenance. It also serves as a mechanism to integrate engineering practices and the curriculum to achieve the overall Program Outcomes and Graduate technologists' attributes. Whereas, it provides exposure to engineering processes at a practical level; helps developing professional skills required by an undergraduate technologist it also offers opportunity to the prospective employer to assess potential of the probable future employee.

**Credit Hour:** The term "Credit Hour (Cr.Hr)" refers to a unit of academic credit during a semester. Each credit hours defined as "one contact hour per week" for the theory class and "3 contact hours per week" for the laboratory work.

**Contact Hours:** (Theory / Lecture): One (1) contact hour per week for each credit hour of Theory/Lecture.

**Contact Hours (Practical):** Three (3) contact hours per week for each credit hour of laboratory work.

**Objectives**

Through the Industrial Training, students will be able: -

To apply engineering knowledge learned in classroom environment in real industrial situations;

To expose to professional engineering practices in the industries.

To understand the role and responsibilities and code of ethics that BSc Engineering Technologists should uphold.

To develop awareness about general workplace behaviors and build interpersonal skills.

To prepare professional work records and reports.

To build rapport and network with probable future employers to increase employability.

**Obtaining Industrial Placement**

During 7th and 8th semester BSc Technology students will be undergoing continuous Industrial Training of 32 weeks. This training will be arranged by HEI's, mainly in the leading Industry and must have MOU on training of Technologists. The designated Training Administrator of HEI may complete all necessary documentation within 12 weeks prior to the commencement of the training and subsequently issue Training Schedule of 32 Weeks to help students undergo training in 7th and 8th semester on due time.

**Student's Responsibility**

BSc Engineering. Technology Students **MUST** get enrolled for the Industrial Training during 6th semester and before commencement of 7th semester. The students will have to undergo continuous training of 32 credit hours. One week's training @ 8 hours daily for 5 days per week will be counted as 1 credit hour. Accordingly, 16 weeks/semester x 5 working days / week x 8 hours/ Day = 640 Contact hours/ semester or 1280 contact hours in 7th and 8th semester.

Trainees will maintain a daily

**Log Book**, duly signed by the Training supervisor at site, Training Administrator appointed by HEI and the Student himself. Students must observe safety & security rules of the Organization where they receive training. Student must wear specified working dress during training. All rules and regulations of the organization will be observed. Trainees must observe working Timings of the Training Organization.

Trainees are allowed to avail 10 days leave during Training period of 32 weeks in total and only 1-day leave will be granted at a time. The leave shall only be availed to cater for any emergency, with prior sanction from the training Administrator. Leave will be treated as loss of training hours

and required to recoup in any case. And any leave availed on discretion will be treated as absent, liable to disciplinary action. Public holiday and leaves should not be counted as working hours.

**HEI's Training Administrator Visit**

HEI's Training Administrator will pay off and on visits throughout the industrial training period. The students and the training organization will be informed about the date and time of the visit. Discussions will be held with the onsite training supervisor(s) as well as the students during the visits.

The purposes of the Training Administrator's visit to the training places are as follows:-

To ensure that the training organization is providing suitable training to the students that they need.

To obtain feedback on training program, students' performance and training progress through discussion with training supervisor(s).

To make courtesy visits and establish industrial relations between the HEI and the industries/ Fields where would be Technologists receive training.

To discuss the possibility of students' job placement with the training organization.

To survey for new industries as potential training placement in the future.

**IMPORTANT NOTE!**

Students are **NOT ALLOWED** to change placement during the training period with particular organization.

However, written permission may be sought from training Administrator, if prior confirmation of newer placement of the student is available .And the student does not suffer loss of training hours due to this changeover.

After getting a written permission from the Training Administrator, a fresh approval should be applied for the new placement.

**Daily Training Logbook**

All the training activities need to be recorded on daily basis. This logbook is to portray :-

A reflection of the student's learning and experience during the industrial training;

Training records and evidences of supervised training and reference of participation of Student, On the job

**Trainer and HEI's training Administrator.**

Part of professional practice in engineering profession where incidence and evidence are recorded in proper documentation.

Source of reference to prepare the Industrial Training Report. The log book must be submitted together with the Industrial Training Report. Students must get it signed, on daily basis, by the On the Job Trainer.

**Industrial Training Report**

An industrial training report will be submitted upon completion of training. The report must describe student's learning and development in technical knowledge, engineering practices and professional skills acquired through the practical experience. The industrial training report should also reflect student's ability in communicating skills understanding of engineering practices.

Students should seek advice from their "On the job Trainer" at site, to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator. The student should be able to present a copy of the report to the prospective employer, as a complement for their Cooperation. Any references made in preparation of the report should be recognized using standard referencing formats. Student should refer to the Industrial Training Report Template guideline are given here under in preparing the report. The Daily Training Logbook should be submitted together with the report.

**Guideline for Preparation of Industrial Training Report**

Students, under the guidance of supervisor, need to properly document their experience and learning during the industrial training in the form of report. A properly prepared report can portray their practical experience precisely in an orderly manner.

The report has to be prepared according to the format and the guidelines below :-

**Contents and Format of the Report**

**Table of Content**

This section of the report should consist of:

Headings

Sub-headings

Page numbers

Every appendix requires a title and each page need to be numbered accordingly.

Background/Profile of the Training Organization

Brief and concise description of the organization in which the student is undertaking the industrial training. The

main items are:

Backgrounds/profile of the organization

Vision and Mission

Organogram.

Title and position of the supervisor in charge

Other necessary information only (not more than three pages)

**Schedule of duties performed as Trainee**

This section should be a brief description of the time, duration and types of duties performed during the training.

The description must follow the schedule of the training i.e. in chronological order (for 32 weeks). The days when the student was not on duty must be properly recorded with cogent reasons.

**Working Experience**

In this section, the student must fully describe the industrial training experience gained. Some suggested areas to be discussed include but not limited to:

Project (s) carried out, if any .

Supervisory works

Problems encountered

Problems solving process or approach

Hands on skill acquired.

How productivity can be further enhanced.

Quality Management system in place.
Safety at work.

**Conclusion**

Student should provide an overall discussion in this section and arrive at a conclusion with regards to the industrial training undergone. Contents may include:

Types of major work performed

Comments on whether the training objectives are met

Suggestions / Recommendations

**References**

A complete list of the references used in the report must be included according to standard referencing format.

**Appendix**

Appendixes are additional information considered appropriate to support the main text. A copy of the letter of permission from the Training organisation must be attached in the appendix. Other suggested appendixes are:

Investigation/project report during the industrial training

Technical drawings, so far these are not secret documents or proprietary etc.

**Others**

**Figures /Tables**

All figures, tables and similar contents must be captioned / labeled and mentioned in the main text.

**List of Notations and Symbols**

If the report contains notations and symbols, the full definition must be given when each notation or symbol first appeared in the main text. The list of notations and symbols with the full definitions can be placed after 'Tables of Contents'.

Every appendix must have a title and be mentioned in the main text where appropriate. All page numbers for appendixes must be continual from the main text.

**DO NOT include irrelevant materials, e.g. brochures from the organizations, or any publicity materials in the report.**

**Note on Good Practice:**

Students are advised to start writing the industrial training report soonest, after beginning of the training period to ensure a timely completion and submission of the report.

**General Report Format**

The report has to be typewritten on white A4 size paper, with 12- point font size, Times New Roman font type and line spacing of 1.5 throughout the report. The report has to be properly ring-bound with transparent plastic sheets attached to the front cover. A sample of report template is available in Appendix A.
The format for the front cover should be as shown in Appendix A.

**IMPORTANT NOTE!**

Students are **NOT ALLOWED** to change the form / template in any way.

**Abstract/Preface**

This section of the report should consist of brief description of the following.

Activities of the Organization

Summary of the report

Acknowledgement

An abstract should be limited to a maximum of two (2) pages only.

**Industrial Training Assessment**

The industrial training performance assessment will be based on

On the Job Trainer' Report (20%)

Training Advisor report through visit or survey (10%)

Industrial Training Report (50%)

Viva voce (20%)

A total of minimal 50% marks must be achieved in order to be considered passing the industrial training during

**7th & 8th semesters.**

Students are advised to give a serious consideration in writing their report. The report must be in good quality and portray all industrial experience and knowledge gained. The report MUST NOT b*e in the form of short note andfigurative form.* ***If the report is not satisfactory, the students may be advised to rewrite the report until it is deemed satisfactory.***

**Completion of Industrial Training**

Upon completion of a 32 weeks continuous training period, a confirmation letter to this effect MUST be obtained from the training organization / probable employer. The confirmation letter needs to be submitted to the Industrial Training Administrator, together with the On the Job Trainer's Report form, Student Feedback form and Industrial Training Report for grading.

*****Student should submit hard copy to the Industrial Training Administrator for evaluation***

Subsequent upon successful completion of the Industrial Training of 32 weeks, a confirmation letter will be included in student's file, as evidence of a successfully completed industrial experience. And to this effect a Training Certificate will also be issued by the Training Organization and countersigned by the HEI's Training Administrator.

**Administration**

All Administrative matters regarding BSc Technologists placement for Training in various industrial units offering free of cost training facilities, will be handled by the Administrator

Industrial Training and maintain records of placement, approvals and training programs devised by respective units & others. All Training reports submitted by the students and given by the respective Training Advisors of training units, will be evaluated and maintained as well, and grades communicated to the relevant Technology Department.